Registered at the G.P.O. for Transmission to Canada and Newfoundland by Magazine Post.

VOL. 31. Ser. A. Part 5. pp. 185–232. MAY, 1943.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY.

LONDON:
THE IMPERIAL INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.,

Price 3s. net.

IMPERIAL INSTITUTE OF ENTOMOLOGY.

Executive Council.

SHAMALDHARI LALL, C.I.E., Officiating High Commissioner, *Chairman*, India and Burma.

J. A. CALDER, C.M.G., *Vice-Chairman*, Colonies, Protectorates and Mandated Territories.

Sir DONALD FERGUSSON, K.C.B., United Kingdom.

Lieutenant-Colonel J. G. ROBERTSON, Canada.

F. L. McDOUGALL, C.M.G., Australia.

F. J. DU TOIT, Union of South Africa.

A. L. POOLE (*acting*), New Zealand.

J. M. ADAMS, F.R.C.Sc.(I), Eire.

D. JAMES DAVIES, C.B.E., Newfoundland.

W. C. ROBERTSON, Southern Rhodesia.

Sir DAVID CHADWICK, K.C.M.G., C.S.I., C.I.E., *Secretary*.

Director and Editor.

Dr. S. A. NEAVE, C.M.G., O.B.E.

Head Office—British Museum (Natural History), Cromwell Road, London, S.W.7.

Publication Office and Library—41, Queen's Gate, London, S.W.7.

Director, Imperial Parasite Service.

Dr. W. R. THOMPSON, F.R.S.,

228, Dundas Street, Belleville, Ontario, Canada.

ISELY (D.). **Insect Problems resulting from Changes in Agriculture in Arkansas.** —*J. econ. Ent.* **35** no. 4 pp. 473–477, 9 refs. Menasha, Wis., 1942.

The following is based almost entirely on the author's summary. New combinations or changes in proportions of crops in Arkansas have introduced new insect problems and intensified others. If the production of a crop that is a favoured food-plant of a given pest is expanded, this pest may incidentally damage less favoured food-plants in the vicinity. In this manner, the great increase in acreage of soy beans and lucerne has favoured abundance of *Melanoplus differentialis*, Thos. [*cf. R.A.E.*, A **28** 170, etc.], and consequently of *Epicauta lemniscata*, F., which feeds on the eggs of grasshoppers in the larval stage and on the same food-plants as grasshoppers in the adult stage. When abundant, these insects destroy maize, cotton, pastures or vegetable crops.

If two or more crops in the same neighbourhood are attractive in succession to an injurious insect, and the acreage of the crop that serves as the earlier food-plant is greatly increased, the crop with the smaller acreage may be severely injured as a result of migration. This is illustrated by the migration of large populations of *Cerotoma trifurcata*, Forst., from soy beans to snap beans in midsummer and of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) from vetch and lucerne to garden peas in late spring.

Some insects that formerly had suitable food-plants only during part of the season have recently become more destructive since satisfactory food-plants have been grown throughout the season. Thus, larger acreages of small grains adjacent to maize, and even of early maize near late maize, have favoured *Blissus leucopterus*, Say ; the large increase in planting of soy beans and of early maize has made possible a much greater multiplication of *Heliothis armigera*, Hb. ; and early maturing maize also prolongs the season during which abundant food is available for pests of stored grain, particularly *Calandra* (*Sitophilus*) *oryzae*, L., and *Sitotroga cerealella*, Ol. The numbers of these insects usually become insignificant about mid-summer, when little stored grain is available, but some migrate to the field and, if they find mature maize ears, breed in them until they are harvested. A change in crop sequence, resulting from a change in proportionate acreage, in which maize is grown each year instead of alternating with cotton, has resulted in severe damage to the maize by *Diabrotica longicornis*, Say, which was formerly controlled by the rotation.

MCGARR (R. L.). **Relation of Fertilizers to the Development of the Cotton Aphid.**—*J. econ. Ent.* **35** no. 4 pp. 482–483, 1 graph. Menasha, Wis., 1942.

Observations having indicated that the use of nitrogenous fertilisers or nitrogen-producing crops on land planted to cotton stimulates the development of *Aphis gossypii*, Glov., when calcium arsenate is used against other insects, an experiment was carried out in Mississippi in 1941, on land on which no fertiliser had been used in recent years, to obtain more definite information on the relation of nitrogen in the fertiliser to the abundance of the Aphid. Infestations on cotton after treatment with fertilisers containing different amounts of nitrogen, but fairly constant amounts of phosphoric acid and potash, applied at the rate of 600 lb. per acre in April, just before planting, and with calcium arsenate dust, applied at the rate of about 6 lb. per acre at approximately 5-day intervals from the end of June, when the cotton was beginning to flower, were compared with those following calcium arsenate dust alone, fertiliser alone and no treatment ; six effective applications of calcium arsenate were made. Records made on the day before the first dust was applied and at approximately weekly intervals showed that Aphid populations increased slowly in all plots for about a month and then very rapidly in the dusted plots, and that infestation by the boll weevil [*Anthonomus grandis*, Boh.] was significantly higher in undusted than in dusted plots. The nitrogenous fertiliser caused no appreciable increase

(644) Wt. P11/3728 1,500 5/43 S.E.R. Ltd. Gp. 432. [A]

in Aphid populations when calcium arsenate was not used, but the increase caused by the latter was greater when fertilisers were used, the average number of Aphids per sq. in. leaf surface for the four last examinations being 6·75, 8·34, 8·88 and 9·76 when the dust and fertilisers containing 0, 2·29, 4·08 and 6·53 per cent. nitrogen were used, 6·05 when the arsenate only was applied, and 0·91 on untreated land and 1·07 on land treated with fertiliser (6·53 per cent. nitrogen) only.

YOUNG (M. T.), GARRISON (G. L.) & GAINES (R. C.). **Experiments on Time to begin dusting with Calcium Arsenate and Number of Applications for Boll Weevil Control.**—*J. econ. Ent.* **35** no. 4 pp. 484–486. Menasha, Wis., 1942.

To determine when dusting with calcium arsenate should begin and the number of applications necessary for the most economical control of the boll weevil [*Anthonomus grandis*, Boh.] on cotton in Louisiana, the yields obtained with applications at 4- or 5-day intervals, beginning when 10 per cent. of the squares were infested and continuing for as long as necessary, were compared with those from smaller numbers of applications begun at different infestation levels and at the time of weevil migration from field to field, during the first week in August.

The average increases in yield in lb. seed cotton per acre were 506 for six applications begun when infestation was 10 per cent., 196 for three applications before migration and 285, 239 and 137 for three, two and one beginning at migration, during 1940 and 1941 ; 522 and 580 for eight applications from 8 per cent. infestation and five from 25 per cent., respectively, and 350, which is significantly less, for four from 70 per cent., in 1940 ; and 54 and 66 (non-significant) for six applications from 30–40 per cent. infestation and five from 50–60 per cent., respectively, in 1941.

YOUNG (M. T.), GARRISON (G. L.) & GAINES (R. C.). **Boll Weevil Control with Calcium Arsenate applied at different Times of Day and at different Time Intervals.**—*J. econ. Ent.* **35** no. 4 pp. 487–489, 1 ref. Menasha, Wis., 1942.

An account is given of two series of experiments carried out in Louisiana to compare the yields of seed cotton obtained when undiluted calcium arsenate was applied for the control of *Anthonomus grandis*, Boh., at 4- or 5-day intervals between daybreak and 7 a.m., between 1 and 3 p.m. and between 6 and 7.30 p.m. and when it was applied in the early morning at 4-, 6- or 8-day intervals. During 1934–35 and 1938–41, applications made during the early morning gave an average increase of 309 lb. per acre over the control plots, those near midday gave 311 lb., and those during the late afternoon 264 lb. [*cf. R.A.E.*, A **29** 358]. In 1934–41, applications at 4-day intervals gave an average increase of 208 lb. per acre over the control plots, those at 6-day intervals gave 143 lb. and those at 8-day intervals 100 lb.

YOUNG (M. T.), GARRISON (G. L.) & GAINES (R. C.). **Calcium Arsenate with and without Aphicides for Control of Boll Weevil and Cotton Aphid.**—*J. econ. Ent.* **35** no. 4 pp. 490–492. Menasha, Wis., 1942.

In experiments against *Anthonomus grandis*, Boh., and *Aphis gossypii*, Glov., on cotton in Louisiana in 1941, undiluted calcium arsenate, zinc-safened calcium arsenate (3·4 per cent. zinc oxide, pH 10·5), mixtures of calcium arsenate and derris, cubé or timbo (0·5 per cent. rotenone) and calcium arsenate mixed with nicotine sulphate solution to give nicotine contents of 0·5, 1 and 2 per cent. or with a dust containing free nicotine to give 1 per cent. nicotine were equally effective against the weevil, giving significant control. Calcium arsenate and zinc-safened calcium arsenate both caused significant increases in the numbers of Aphids and resulted in no increase in yield over the control plots,

but the mixtures of calcium arsenate with derris, cubé and timbo, which were equally effective, kept the Aphid population at about that in untreated plots and caused significant increases in yield when compared with calcium arsenate alone. Calcium arsenate and 1 per cent. nicotine from nicotine sulphate or free nicotine gave better control of Aphids and higher yields than calcium arsenate with rotenone, and calcium arsenate with nicotine sulphate (1 per cent nicotine) was more effective against the Aphids than that containing free nicotine. A mixture of calcium arsenate and 0·5 per cent. nicotine applied in the late afternoon gave better Aphid control and a higher yield than a similar mixture or one of calcium arsenate and rotenone applied in the early morning. Alternate applications of calcium arsenate and a mixture of calcium arsenate and 2 per cent. nicotine gave much more effective control of Aphids and higher yields than alternate applications of calcium arsenate and mixtures containing 1 or 0·5 per cent. nicotine.

GAINES (R. C.). **Effect of Boll Weevil and Cotton Aphid Control on Yield as shown in a factorial Experiment in 1941.**—*J. econ. Ent.* **35** no. 4 pp. 493–495, 2 refs. Menasha, Wis., 1942.

Factorial experiments to determine the comparative effect on infestation and yield of cotton of treatment with calcium arsenate dust for the control of *Anthonomus grandis*, Boh., and with nicotine against *Aphis gossypii*, Glov., and of a combination of the two treatments [*cf. R.A.E.*, A **30** 252] were continued in South Carolina, Florida, Louisiana and Texas in 1941. The nicotine was applied in a spray at the rate of about 2 lb. nicotine sulphate (40 per cent.) per 100 U.S. gals. water in Florida and in a dust of tobacco and lime (9 : 1) to which the nicotine sulphate was added to give a nicotine content of approximately 3 per cent. in the other States. Comparison of the results from treatment with calcium arsenate or calcium arsenate and nicotine with those from no treatment or treatment with nicotine showed that the arsenate caused significant reductions in weevil infestation in all localities, significant increases in numbers of Aphids in all localities except in Louisiana and significant increases in yield in all except Florida and Louisiana, the increase in yield in Texas being partly due to the control of the bollworm [*Heliothis armigera*, Hb.]. Similar comparisons showed that nicotine gave significant reductions in Aphids, except in Louisiana, and significant increases in yield in Florida and Louisiana, and that calcium arsenate and nicotine interacted to cause significant reductions in Aphids at all localities and a significant increase in yield in Louisiana. Calcium arsenate gave significant increases in yield over the control plots of 391, 64 and 45 per cent. in South Carolina and Louisiana, where weevil infestation was heavy, and Texas, where it was intermediate, nicotine gave non-significant increases in Florida, Louisiana and Texas, and calcium arsenate and nicotine together gave significant increases of 418, 128 and 41 per cent. in South Carolina, Louisiana and Texas, and increases that were not significant in another experiment in Louisiana and in Florida. Calcium arsenate and nicotine gave significant increases in yield over calcium arsenate alone of 78 and 39 per cent. in Florida and Louisiana and insignificant increases in South Carolina and in another experiment in Louisiana.

BONDY (F. F.) & RAINWATER (C. F.). **Boll Weevil Hibernation, Survival, and Emergence under South Carolina Conditions.**—*J. econ. Ent.* **35** no. 4 pp. 495–498, 2 refs. Menasha, Wis., 1942.

An account is given of studies on the factors that influence the abundance of *Anthonomus grandis*, Boh., on cotton, with particular reference to survival of the winter and emergence, made in South Carolina in connection with investigations on the control of the weevil. In cage tests carried out in 1931–41, only a small proportion survived even the mildest winters, temperature was

the most important factor affecting survival, which averaged 0·21 per cent. in four years when the minimum temperature was below 15°F. and 5·67 per cent. for five years when it was 19° or above [*cf. R.A.E.*, A **18** 169]. The numbers of weevils that survived in cages were considerably higher in trash from the woods and lower in maize stalks than in Spanish moss, and higher in cages in the woods than in those in the open fields. The average survival of weevils placed in the cages in the open field on 15th November was more than twice that of those installed on 15th October, showing the value of early destruction of cotton stalks in compelling the weevils to enter hibernation early and in a weakened condition owing to lack of food.

Regular examinations of Spanish moss hanging from the branches of trees near cotton fields in 1928–38, made during autumn to determine the relative number of weevils that hibernate in it and in spring to find the proportion that survive the winter, showed that comparatively large numbers hibernated in this material when it was adjacent to cotton fields and that temperature was an important factor affecting survival. Of weevils found in the moss in spring, 70·2 and 0 per cent. were alive after winters with lowest minimum temperatures of 23 and 2°F., respectively. In systematic examinations to determine the number of weevils hibernating in trash in woods, begun in 1937–38, 78 per cent. of the weevils found were within 50 ft. of the edges of the woods bordering cotton fields and practically none more than 150 ft. from the edges, indicating the uselessness of burning large areas of woods for weevil control. It is considered that correlating the results of examinations of trash with prevailing seasonal weather conditions over a number of years will give a more reliable index of probable abundance than was obtained from examinations of Spanish moss. A study of the period when weevils emerged from natural hibernation and entered the cotton fields was made each year from 1938 in an isolated trap plot of early-planted cotton by examining each plant at least three times a week from the time that the cotton was large enough for weevils to feed on until 1st July ; every weevil was counted and killed and every square that formed was removed so that no new weevils could develop. It was found that approximately 88 per cent. of the total emergence occurs in June and about 46 per cent. in the second half of the month. Mopping the cotton with sweetened poison is not effective in control after squares are large enough for the insects to feed on, and since such squares are usually available by 15th June in this district and a large emergence occurs later, this method of control is quite unreliable [*cf.* next abstract].

BONDY (F. F.). **Mopping, Dusting, and Combination Treatments for Boll Weevil Control in South Carolina.**—*J. econ. Ent.* **35** no. 4 pp. 498–499. Menasha, Wis., 1942.

The following is substantially the author's summary. A total of 187 field experiments were carried out against the boll weevil, *Anthonomus grandis*, Boh., at Florence, South Carolina, in 1928–41 to determine the comparative value of a mopping mixture of calcium arsenate, molasses and water (1 : 1 : 1) applied to cotton in the presquare stage, calcium arsenate dust applied after 10 per cent. of the squares had been punctured and a combination of these two treatments. The average increases in yield over comparable untreated plots were 39, 286 and 331 lb. seed cotton per acre, respectively, with average net profits of $1·10, $9·60 and $11·40 per acre for the three treatments.

RAINWATER (C. F.). **Rotenone in Combination with Calcium Arsenate for Cotton Aphid Control.**—*J. econ. Ent.* **35** no. 4 pp. 500–503, 4 refs. Menasha, Wis., 1942.

This is a discussion of the control of *Aphis gossypii*, Glov., and the increase in yield of seed cotton obtained under a wide variety of conditions in South

Carolina, Georgia, Florida, Mississippi, Louisiana and Texas when ground derris root was added to calcium arsenate, applied against *Anthonomus grandis*, Boh., to give rotenone contents of 0·1–0·5 per cent. It was found that calcium arsenate with 0·5 per cent. rotenone was effective in keeping the Aphid population at or below that in untreated plots and caused a significant increase in yield over plots treated with calcium arsenate alone under conditions of heavy boll weevil injury [*cf. R.A.E.*, A **30** 43, 428]. This mixture gave insignificantly greater increases in yield and fewer Aphids than one of equal quantities of calcium arsenate and sulphur containing 0·25 per cent. rotenone, and usually significantly higher yields than calcium arsenate alone, whereas the other mixture did not. Smaller proportions of rotenone in either mixture were not very effective in preventing increase of Aphids.

The records obtained in Louisiana showed that cubé and timbo were as effective as derris as sources of rotenone [*cf.* **31** 186] and those from South Carolina that diatomaceous earth, clay, pyrophyllite and walnut-shell flour were as effective as sulphur as diluents for calcium arsenate and rotenone.

In general, the data from these experiments confirm the results of earlier investigations. Where control of *A. grandis* was not a factor, the plots treated with the mixtures of calcium arsenate and rotenone were comparable with the untreated plots in both Aphid population and yield, and where it was, these mixtures gave highly significant increases in yield over the control plots and significant increases over the calcium arsenate plots.

FISHER (R. A.) & SHULL (W. E.). **Insecticidal Control of Legume Bugs in Seed Alfalfa.**—*J. econ. Ent.* **35** no. 4 pp. 503–507, 4 graphs, 7 refs. Menasha, Wis., 1942.

Since Capsids, particularly *Lygus hesperus*, Knight, and *L. elisus*, Van D., contribute to many of the failures in the production of lucerne seed in the western United States, investigations on their control by insecticides, which is desirable in areas and seasons in which cultural practices cannot be successful, were carried out in Idaho in 1937, when pyrethrum preparations were effective in cages but not in the field in limited tests, and in 1938, 1940 and 1941. Cage tests with *L. atriflavus*, Knight, and small numbers of *L. elisus* and *L. hesperus* showed no significant difference between dusts of Dry Pyrocide in talc (0·25 per cent. pyrethrins) and cubé in sulphur (0·88 per cent. rotenone), applied against adults, but significantly lower toxicity for one of 25 per cent. Paris green, containing at least 50 per cent. As_2O_3, in sulphur, and no significant difference between sulphur, diatomaceous earth and talc as carriers of cubé. The addition of three parts by weight of steam-distilled pine oil to the cubé-sulphur dust did not increase its effectiveness. The mortality of adults due to pyrethrum and cubé dusts was nearly twice that of nymphs in the third, fourth and fifth instars, and increasing the deposit of cubé from 12 to 50·5 mg. per sq. cm. did not cause a significant increase in nymphal mortality. A dust of Dry Pyrocide and cubé in talc, containing 0·25 per cent. pyrethrins and 1 per cent. rotenone, gave high mortality of both stages, and particularly of adults ; dusts containing 1 per cent. rotenone and 0·1, 0·125 and 0·25 per cent. pyrethrins showed no difference in control of nymphs during June, but differed significantly in July, when the nymphs were more resistant, possibly because of climatic changes ; and tests with dusts containing 0·125 per cent. pyrethrins and 1, 0·5 and 0·25 per cent. rotenone showed that the rotenone content could be reduced to 0·5 per cent. without materially reducing the effectiveness of such a dust.

In 1938, when populations were low towards the end of the season, a dust containing 0·25 per cent. pyrethrins caused a considerable reduction in population in the field. In 1940, pyrethrum dust gave better results than cubé or Paris green in small field plots, causing 45 per cent. reduction when applied just as the plants were beginning to bloom, but none of the dusts was effective

two weeks later. In 1941, a mixture containing 0·25 per cent. pyrethrins and 1 per cent. rotenone gave poor kills when applied at the rate of 25 lb. per acre, but nearly 90 per cent. control when applied at 35 lb. per acre shortly before blooming. Results with a second application were not so good, and in all cases the plots were heavily reinfested within a few days, and no benefit was derived from the treatments. Power-driven dusters with canvas trailers over the nozzles gave unsatisfactory results when plant growth was heavy.

Preliminary laboratory tests indicated that a dust of 20 per cent. sodium arsenite in diatomaceous earth was as toxic as one containing 0·125 per cent. pyrethrins and 0·5 per cent. rotenone at a low rate of application and may be of value in field control; a dust containing only 10 per cent. sodium arsenite was less toxic.

METCALF (C. L.). **Mexican Fruitfly found in Illinois.**—*J. econ. Ent.* **35** no. 4 p. 507. Menasha, Wis., 1942.

The author reports the discovery in Illinois in late April 1942 of six larvae of *Anastrepha ludens*, Lw., in a grapefruit from Texas. Examination of several dozen grapefruits that were supposed to have reached Illinois in the same shipment failed to reveal further larvae.

BLANCHARD (R. A.) & SATTERTHWAIT (A. F.). **Manual Infestation of Corn Strains as a Method of determining differential Earworm Damage.**—*J. econ. Ent.* **35** no. 4 pp. 508–511, 2 refs. Menasha, Wis., 1942.

The author describes a method of producing controlled infestation of ears of maize by *Heliothis armigera*, Hb., devised in central Illinois in 1936–41. Adults for oviposition were reared from larvae collected on maize and tomato in southern Illinois and south-eastern Missouri or taken from early market maize from the south in 1936, and from larvae collected in the previous autumn and stored as pupae at a temperature of about 45°F. until required or, later in the season, from larvae collected during the summer in local fields, in subsequent years. Several females were confined with males of about equal age in screen cages measuring 12 ins. each way and provided with cheesecloth on which to oviposit, over the door, which was the only side not darkened, and hanging in narrow strips. Beer that had not previously been cooled below air temperature was the most satisfactory food, though a solution of strained honey, distilled water and yeast was fairly satisfactory. Sections of cheesecloth on which were up to 200 eggs were placed in vials plugged with moist cotton-wool and kept at outdoor temperatures or at 90–95°F. if a short incubation period was desired, or stored at 45° for 5–6 days if necessary. The larvae were transferred to fresh maize silks by means of a moistened camel-hair brush as soon as possible after hatching; 5–7 larvae per ear, 2–4 placed at one time and the remainder after 3–6 days, resulted in the most severe damage to the test ears.

This method of infestation can be uniform from year to year, whereas natural infestations are subject to wide variations, and it can be used effectively in maize-breeding operations by placing the larvae on silks under the pollination bags.

BARBER (G. W.). **Control of Earworms in Corn by Birds.**—*J. econ. Ent.* **35** no. 4 pp. 511–513. Menasha, Wis., 1942.

The following is based on the author's summary. A description is given of a five-acre field of maize in Georgia in which 961 of 1,000 ears examined in late July were or had been infested by larvae of *Heliothis armigera*, Hb., and *Laphygma frugiperda*, S. & A. Of the larvae found, 65 per cent. were *Heliothis* and 35 per cent. *Laphygma*. Birds, mainly the hairy woodpecker [*Dryobates villosus*], had attacked 712 of the 1,000 ears, usually having drilled through

the husks to reach the larvae, although birds do not usually feed on more than 1 per cent. of the ears in a given field. From a comparison of the kernel injury in ears not attacked by birds and containing larvae or larval exit holes and in ears that the birds had attacked, it was found that kernel injury in 345 of the ears had probably been prevented by birds, which removed the larvae before they had penetrated far enough into the ears to reach the kernels. The reason for the large proportion of the larvae attacked by birds in this field seemed to be that favourable nesting sites for woodpeckers were plentiful in neighbouring woodlands and scattered shade trees ; usually maize fields are not surrounded by woodlands to a similar degree and fewer birds occur near them.

SNAPP (O. I.). **Further Tests of Dichloroethyl Ether and of Jarring to control Plum Curculio.**—*J. econ. Ent.* **35** no. 4 pp. 514–516, 3 figs., 1 ref. Menasha, Wis., 1942.

The results are given of further experiments with dichloroethyl ether for soil treatment against *Conotrachelus nenuphar*, Hbst., on peach in Georgia [*cf. R.A.E.*, A **28** 170] carried out in 1939–41 to determine whether the quantity of insecticide or diluent could be reduced. When it was desired to use the ether at a concentration higher than 1 per cent., it was emulsified with potash fish-oil soap by stirring 9 parts by volume into 1 part soap to give a 90 per cent. stock emulsion. In the laboratory, with at least 750 individuals per test, spraying the soil with $\frac{1}{3}$ fl. oz. dichloroethyl ether per sq. yd. against the larvae resulted in the emergence of no adults when it was applied in 1 or $\frac{1}{3}$ U.S. gal. water, and of 17 when applied in $\frac{1}{6}$ U.S. gal., and 1 fl. oz. gave complete kill of pupae in 1 or $\frac{1}{3}$ U.S. gal. or 7 fl. oz. water in 1939 ; in 1940, 104 and 20 adults emerged from thoroughly wet soil to which $\frac{1}{3}$ fl. oz. in $\frac{1}{6}$ and 1 U.S. gal. water, respectively, was applied against the larvae, and only 9 and 8 from very damp soil treated with 1 fl. oz. in $\frac{1}{6}$ U.S. gal. and 7 fl. oz., respectively, against the pupae and none from similar soil treated with 1 fl. oz. in 1 U.S. gal. Sulphated alcohol did not improve the effectiveness of dichloroethyl ether against either larvae or pupae. Individual records showed that at the rate of $\frac{1}{3}$ fl. oz. per sq. yd., the ether killed most of the larvae within three days of treatment in dry soil, but had not killed them all after 15 days in thoroughly wet soil, and that at 1 fl. oz. per sq. yd. it killed all pupae within two days in dry soil and in six days in very damp soil.

In 1939, when each of three caged trees was artificially infested with about 465 larvae in addition to those already present on them, and the soil was treated with $\frac{1}{3}$ fl. oz. dichloroethyl ether in $\frac{1}{3}$ U.S. gal. water per sq. yd. when most of the insects were present as larvae and with 1 fl. oz. in 1 U.S. gal. when most of them were pupae, only one adult emerged. In 1940, when each of four trees was infested with about 350 larvae and the soil received one application at the rate of 1 fl. oz. in $\frac{1}{6}$ U.S. gal., with 0·2 per cent. sulphated alcohol, four adults emerged. In 1941, when each of four trees was infested with about 883 larvae and the soil was sprayed with $\frac{1}{3}$ fl. oz. dichloroethyl ether in $\frac{1}{6}$ U.S. gal. per sq. yd., chiefly against the larvae, and with 1 fl. oz. in $\frac{1}{6}$ U.S. gal., chiefly against the pupae, 13 adults emerged.

In 1941, the following treatments were compared in a commercial orchard, the percentage of peaches infested at harvest being shown in brackets : the regular spray schedule of 2 lb. lead arsenate and 8 lb. hydrated lime per 100 U.S. gals. at petal-fall, sepal-fall and four weeks before harvest (8) ; the same schedule with twelve jarrings for overwintered adults and seven for first-generation adults (4·1) ; the same lead-arsenate spray at sepal-fall only and one application of 1 fl. oz. dichloroethyl ether per sq. yd. (11·7) ; one application of 1 fl. oz. dichloroethyl ether per sq. yd. and twelve jarrings for overwintered adults (11·5) ; and two applications of the ether at $\frac{1}{3}$ and 1 fl. oz. per sq. yd. and twelve jarrings for overwintered adults (7·2). In each case the ether was in an emulsion, of which only $\frac{1}{6}$ U.S. gal. was applied per sq. yd. Analysis of these results

showed that the last treatment is as effective as the regular schedule of lead arsenate sprays on the fruit. Two applications of dichloroethyl ether gave much better control than one, and one application of lead arsenate at sepal-fall and one of dichloroethyl ether gave the same control as one of dichloroethyl ether accompanied by jarring against the adults.

No injury to vegetation under the peach trees or to any part of the trees could be observed after two applications of dichloroethyl ether to the soil, whereas the regular schedule of lead arsenate caused very heavy foliage injury and some damage to the fruit.

FAHEY (J. E.). **Compatibility of Copper Fungicides with Nicotine Bentonite Insecticides.**—*J. econ. Ent.* **35** no. 4 pp. 517–520, 3 refs. Menasha, Wis., 1942.

The following is substantially the author's summary. The effect of copper fungicides and nicotine-bentonite insecticides on the water-soluble nicotine and water-soluble copper contents of the water phase of spray mixtures of these materials has been studied in the laboratory. The chemical analyses of 17 copper fungicides are reported. Preliminary experiments show that a 1/32 : 1/16 : 100 Bordeaux mixture has a measurable effect on the water-soluble nicotine content of nicotine-bentonite sprays. As the concentration of Bordeaux mixture is increased, there is a corresponding increase in the pH and the water-soluble nicotine content of the spray mixture. Copper fungicides that produce strongly alkaline spray mixtures (above pH 8·5), alone or in combination with nicotine-bentonite insecticides, will result in a large increase in the soluble-nicotine content of nicotine-bentonite spray mixtures. Nicotine-bentonite insecticides that contain or are used with unaltered bentonite reduce the soluble-copper content of the copper fungicide sprays. A factory-processed nicotine-bentonite insecticide was found to increase the soluble-copper content of the fungicide spray mixtures.

These results apply only to spray mixtures and should not be interpreted as applying to spray residues.

YUST (H. R.), BUSBEY (R. L.) & HOWARD (L. B.). **Laboratory Fumigations of the California Red Scale with Methyl Bromide, alone and with Hydrocyanic Acid.**—*J. econ. Ent.* **35** no. 4 pp. 521–524, 7 refs. Menasha, Wis., 1942.

Methyl bromide has been used to some extent in southern California for the control of *Aonidiella aurantii*, Mask., on *Citrus* nursery stock that is to be moved, and this paper comprises an account of laboratory experiments to determine its effectiveness alone and in combination with hydrocyanic acid gas against different stages of a resistant strain of the scale on lemon fruits. Most of the treatments were carried out at a temperature of 77°F. and a relative humidity of 65 per cent., and none caused injury to the lemons. The fumigants were applied in a gas-tight chamber, and the dosages are given in mg. per litre. The insects that were killed by methyl bromide were very slow to develop visible characteristics of death. Preliminary tests with dosages of 40, 60, 80 and 120 mg. for 40 minutes and insects 2–54 days old showed that scales in the early second stage, the early grey adult and the reproducing mature adult were the most difficult to kill. Scales in the first stage were more susceptible than those in the early second stage, and those in the second moult, which are more resistant to HCN than any other stage, were relatively easy to kill. There was considerable variation in the mortality of scales at different ages of the same developmental stage.

Fumigation of early grey adults with 60, 70, 80 and 90 mg. for 40 minutes resulted in approximately 15·1, 61·9, 96·1 and 99·75 per cent. mortality, respectively, and fumigation with 20 mg. for 120, 140, 160 and 180 minutes in 36·5, 87·7, 98·8 and 100 per cent. Treatment of mature females with 70 mg.

for 40 minutes at 50, 63·5 and 77°F. gave 16·4, 42·3 and 99·5 per cent. mortality. Complete mortality was obtained from fumigation of all stages on lemon fruits from the field with 40 mg. for 3 hours in January 1939 and with 60 and 70 mg. at 59°F. and 30 and 40 mg. at 77° for 3 hours in May. The January scales were preconditioned for 20 hours and treated at 77°F. and 65 per cent. humidity.

The addition of 20 mg. methyl bromide to 0·6 mg. HCN increased the average percentage mortality of mature females from 68·4 to 86·6, and the addition of 10 mg. to 0·9 mg. increased that of scales in the late second moult and early grey adults from 75·8 and 64·9 to 87·5 and 89·4, respectively, the exposure periods being 40 minutes, whereas exposing the insects to 10 mg. methyl bromide for 10 minutes and then to 0·9 mg. HCN for 40 minutes reduced it to 67 and 49·6, respectively. Exposure of grey adults to 1·16 mg. HCN or 70 mg. methyl bromide, which were estimated to give approximately equal kills, and to a mixture of 0·58 mg. HCN and 35 mg. methyl bromide resulted in 76·2, 51·8 and 96·8 per cent. mortality, indicating a synergistic action, and treatment of mature females with 0·9 mg. HCN, 60 mg. methyl bromide and a mixture of 0·45 mg. and 30 mg. in 96·7, 96·4 and 90·1 per cent., suggesting antagonistic action.

Kirchner (J. G.) & Richardson (C. H.). **Insecticidal Action of some Pyrrolines and Pyrrolidines on** *Thermobia domestica*.—*J. econ. Ent.* **35** no. 4 pp. 525–530, 18 refs. Menasha, Wis., 1942.

The following is substantially the authors' summary. Fourteen α-substituted pyrroline and pyrrolidine derivatives were tested in the laboratory in comparison with nicotine as contact insecticides against *Thermobia domestica*, Pack. The calculated median lethal concentrations place these compounds in the following decreasing order of toxicity: *l*-α-pyridyl-α-N-methylpyrrolidine (nicotine), 2-mesityl-α-pyrroline, 2-mesityl-α-pyrrolidine, *l*-α-cyclohexylpyrrolidine, *d*-α-cyclohexylpyrrolidine, α-cyclohexylpyrroline, α-thienyl-α-pyrrolidine, *l*-α-phenylpyrrolidine, *d*-α-phenylpyrrolidine, α-n-butylpyrroline, α-phenylpyrroline, α-thienyl-α-pyrroline, *dl*-α-cyclohexylpyrrolidine, α-n-butylpyrrolidine, *dl*-α-phenylpyrrolidine.

Like nicotine, 2-mesityl-α-pyrroline is somewhat unstable in air, owing probably to the reactivity of the C-N bond. This reactivity may account for its relatively high toxicity. A tendency was noticed for most of the pyrrolines to be more toxic than the corresponding pyrrolidines. The *l*- and *d*-forms of α-cyclohexylpyrrolidine were identical or very similar in toxic action, as were also *l*- and *d*-α-phenylpyrrolidine, but each pair of optical isomers was significantly more toxic than its respective racemic compound. These two compounds differ markedly from nicotine and nornicotine with respect to the relation between optical isomerism and toxicity to insects.

The physiological action of these compounds on *Thermobia* resembles that frequently observed for nicotine.

Webster (R. L.) & Carson (E. C.). **Ovicidal Value of light Mineral Oils for the Codling Moth.**—*J. econ. Ent.* **35** no. 4 pp. 530–533, 4 refs. Menasha, Wis., 1942.

In the Pacific Northwest, fractions of petroleum oil having viscosities of 50–70 secs. Saybolt, and usually highly refined (85–90 per cent. unsulphonatable residue), are applied as ovicides against the codling moth [*Cydia pomonella*, L.] on apple in the second and third cover sprays of lead arsenate and fungicide. Since the use of oil later in the season results in greater difficulty in removing spray residues [*cf. R.A.E.*, A **19** 582] there is a tendency to use the lighter fractions (50–55 secs. viscosity), which have been considered to be less effective than medium oils (70–75 secs), at lower concentrations but more frequently, and laboratory investigations were therefore carried out in Washington to determine the value of these light oils as ovicides in the control programme.

In 1938 a highly-refined oil with a viscosity of approximately 42 secs., used with 3 lb. lead arsenate per 100 U.S. gals. water and emulsified with monoethanolamine and oleic acid, killed 89 and 54 per cent. of the eggs at concentrations of 0·5 and 0·25 per cent., respectively. In 1939, light, light-medium and medium oils with unsulphonatable residues of 79, 71 and 66 per cent. gave 74, 84 and 86 per cent. mortality, respectively, when emulsified with oleic acid and ammonia and used at a concentration of 0·5 per cent. without lead arsenate, and light, medium and heavy oils with 90 per cent. unsulphonatable residue gave 77, 86 and 90 per cent. mortality. In 1940, highly refined light, light-medium and medium oils at 0·5 per cent. gave 96, 95·5 (eliminating unusually low results obtained on one day) and 97 per cent. mortality, but a light oil with an unsulphonated residue of 80 per cent. gave only 39 per cent. mortality at a concentration of 0·5 per cent. and 61 per cent. at 0·75 per cent. In 1941, highly refined light, light-medium and medium commercial miscible oils gave 97, 96 and 99 per cent. mortality at 0·5 per cent. and 83, 88 and 96 per cent. at 0·33 per cent. ; at concentrations of 0·66, 0·83 and 1 per cent., the light fraction gave 97, 99 and 100 per cent. mortality. A commercial paste emulsion, which represented a light oil with a high degree of refinement, killed 46, 92 and 99 per cent. of the eggs when diluted to contain 0·25, 0·5 and 0·75 per cent. actual oil.

Upholt (W. M.). **The Use of the Square Root Transformation and Analysis of Variance with contagious Distributions.**—*J. econ. Ent.* **35** no. 4 pp. 536–543, 2 figs., 10 refs. Menasha, Wis., 1942.

The following is the author's summary. The purpose of the statistical tests most frequently used by agricultural entomologists is to aid the experimenter to detect differences in means of plots when important differences do in fact exist. To do this the test must be unbiased, in the sense that it does not indicate a difference when no difference actually exists, with a frequency greater than the level of significance chosen. In addition, it must be sufficiently sensitive to detect important differences with an appreciable frequency when such differences do exist. The analysis of variance and related F-test and t-test are based on hypotheses not always met in entomological practice. The square root transformation has been suggested to make this statistical method more widely applicable to entomological data. The above two properties of the analysis of variance and related tests are investigated in a hypothetical experiment for the case in which the data follow a contagious distribution and are transformed by adding one-half and extracting the square root, before applying the analysis. The transformation is found to introduce a bias into the means, but in reasonable cases this bias is not sufficient to invalidate the analysis. The type of distribution and possible effects of treatments may result in such a great generalised error term that the analysis has very little power to detect rather large differences in means that may occur.

It is concluded that at least until more powerful tests are available for such cases, analysis of variance of the transformed data may be a satisfactory guide for the experimenter if not too much reliance is placed on the results.

Moore (Wm.) & Bliss (C. I.). **A Method for determining insecticidal Effectiveness using *Aphis rumicis* and certain Organic Compounds.**—*J. econ. Ent.* **35** no. 4 pp. 544–553, 2 figs., 7 refs. Menasha, Wis., 1942.

The following is substantially the authors' summary. After preliminary tests with more than 400 chemicals in contact sprays against *Aphis rumicis*, L., five substituted glycinonitriles and a mixture of one of the five (diphenyl glycinonitrile) with dioctyl fumarate were selected for quantitative comparison with a standard nicotine insecticide. Sprays of four concentrations of each compound were replicated on three different days in such a way that every compound was tested once on the same day with every other compound. By a simplified

procedure, which is described, parallel dosage-mortality curves in terms of log-concentrations and empirical probits were computed for the three tests of all seven chemicals and from them the log-concentration killing 95 per cent. of the Aphids. The mean log-LD95 for each chemical was then corrected for differences in the over-all susceptibility of the Aphids between days. The calculation of these relative toxicities and their experimental errors is described in full. Two amyl phenyl glycinonitriles were less than half as toxic as dibenzyl, benzyl phenyl and diphenyl glycinonitriles and the mixture, which all compared favourably with a standard 40 per cent. solution of nicotine.

Hervey (G. E. R.) & Pearce (G. W.). **The Influence of Lime on the Toxicity of Lead Arsenate to Cabbage Worms.**—*J. econ. Ent.* **35** no. 4 pp. 554–558, 3 figs., 2 refs. Menasha, Wis., 1942.

Hydrated lime has been used as a carrier for lead arsenate, applied against *Pieris rapae*, L., and *Plusia* (*Autographa*) *brassicae*, Ril., on cabbage in New York, for a number of years, but experiments carried out in 1940, when both species were abundant, and in 1941, when infestation by *Pieris* was light and *Plusia* was practically absent, showed that the lime reduced the toxicity of the arsenate, as a result of which it has been largely replaced by inert diluents.

In 1940, dusts containing 25 per cent. lead arsenate in hydrated lime, a commercial talc, a commercial clay and Pyrax ABB (pyrophyllite) and sprays containing an adhesive and 5 lb. lead arsenate, with or without 5 lb. hydrated lime, per 100 U.S. gals. were applied three times at intervals of two weeks during the period of maximum insect activity in July and August [*cf. R.A.E.*, A **30** 262] ; and the same treatments, with the addition of a dust of lead arsenate and Pyrax (25 : 75) to which crude soy-bean oil was added at the rate of 2 U.S. pints per 100 lb., were applied in 1941. It was found that, in all cases, the dusts or sprays that contained lime gave less control than those that did not, and that the spray of lead arsenate and the two Pyrax dusts were outstandingly effective. The spray was superior to any dust except the one containing oil. The average residue of arsenic on the leaves, determined on the day of treatment and 10 days later, for each application, showed that the sprays had better adhesive properties than any of the dusts except that containing the oil. Although the residues from the talc, clay and Pyrax dusts tended to be somewhat higher than those from the lime dusts, it is considered that this difference is not sufficient to cause the large difference observed in insect control, which must be due to reduction in the toxicity of the lead arsenate. The pronounced superiority of the dust containing soy-bean oil, however, is probably caused by its property of depositing a much higher initial load of great uniformity, which offers high resistance to weathering. It is suggested that the reduction in toxicity of lead arsenate caused by the addition of lime may be due to the formation in the insect's gut of calcium arsenate, which is frequently less toxic than lead arsenate to Lepidopterous larvae.

Larson (A. O.) & Hallock (H. C.). **Time of planting susceptible Beans in Relation to Curly Top Injury in south-central Idaho.**—*J. econ. Ent.* **35** no. 4 pp. 565–569, 3 figs., 3 refs. Menasha, Wis., 1942.

Since little is known of the relation between date of sowing and injury to beans by the curly-top virus [*Chlorogenus eutetticola* of Holmes], which is transmitted by *Eutettix tenellus*, Baker, and causes heavy losses to the bean crop in some years in south-central Idaho, a highly susceptible variety was sown at intervals of one week in 1936 and 3–4 days in 1937–39 from about 8th May to 29th June in one or more localities, the plants were examined weekly, diseased

ones being removed, and records were made of the date of germination, the number of plants and of diseased plants, the dates on which infestation by *E. tenellus* and infection by curly-top were first observed, and the yield. It was found that, in general, the plants that had been sown early were less infected, became infected at a later stage of growth and gave higher yields per acre and per plant than later ones ; in one district, where the Jassid population was very large, no marketable beans were produced in any plot except in 1939. Surveys to determine the extent of curly-top in commercially grown beans, made in the principal bean-growing districts during eight seasons, showed that it caused severe damage during 1930, 1935 and 1937, when infestation by *E. tenellus* was heavy in the cultivated areas, and very little in 1936, 1938 and 1939, when infestation was light. In all years there was a gradual decrease in the amount of disease from west to east, corresponding to the degree of immigration of the Jassid in the spring. Comparison of the dates of leafhopper movement with the results of the sowing experiments showed that in every instance, beans planted after the beginning of the movement from the spring breeding areas to the cultivated ones had more curly-top than those planted just before migration began. It is concluded that garden beans planted just before or at about the beginning of the spring migration should nearly always escape severe injury from the disease in the eastern districts, but that the growing of susceptible varieties in the western districts is attended by a high degree of risk at any time, though early planting may reduce losses.

HODSON (A. C.). **Biological Notes on the Basswood Leaf-miner, *Baliosus ruber* (Weber).**—*J. econ. Ent.* **35** no. 4 pp. 570–573, 2 figs., 9 refs. Menasha, Wis., 1942.

The leaves of the basswood or American lime (*Tilia americana*) are attacked throughout its range in the United States and Canada by *Baliosus ruber*, Weber, which forms mines in the larval stage and skeletonises the surface, usually the upper one, as an adult. An outbreak of this Hispid has been almost continuous in part of Minnesota since 1935, and repeated attacks have weakened the trees considerably, but very few have died, even where feeding has been heaviest. It has also been recorded as a pest of apple and oak in the United States, but oaks in a mixed stand containing infested basswood were only very slightly damaged. Observations showed that the adults hibernated under leaves and litter beneath the trees and became active in mid-May, when basswood leaves begin to unfold. Feeding increased as the season progressed and skeletonising was becoming conspicuous by 1st June, when mating began. The first eggs were found on 15th June, and pupation began about 1st August and was almost complete by 15th August. The egg, larval and pupal stages lasted about 10 days, 4–5 weeks and 8–12 days, respectively. The young adults began to feed as soon as they emerged and continued to skeletonise the leaves until they entered hibernation. The average number of eggs per female was 37·1 when mating beetles were caged from 27th June 1940 ; they were embedded in the leaves singly, at the edge of areas skeletonised by the females, and the larvae entered the leaf tissue direct from the egg and pupated in their mines.

The author discusses the relation between population density and degree of damage, and the control given by undetermined Hymenoptera that parasitised 100, 98·8, 66·6 and 47·5 per cent. of the eggs in four localities in 1940, as a result of which there were practically no beetles in 1941 in the first two and only light infestations in the third and fourth. Basswood trees in a stand that had been treated with a spray of 2·5 lb. lead arsenate and 1 U.S. pint raw linseed oil per 100 U.S. gals. for the control of *Malacosoma disstria*, Hb., were free from larval mines and showed only very light adult feeding, whereas damage was heavy in a neighbouring unsprayed stand.

YOTHERS (M. A.). *Epicallima coloradella* (**Wals.), an Inhabitant of Perennial Apple Cankers in the Northwest.**—*J. econ. Ent.* **35** no. 4 pp. 573–576, 3 figs., 9 refs. Menasha, Wis., 1942.

In the course of a study in Washington of the relation of *Eriosoma lanigerum*, Hsm., to perennial apple canker, caused by the fungus, *Gloeosporium* (*Neofabraea*) *perennans* [*cf. R.A.E.*, A **17** 666, etc.], the Tineid, *Epicallima coloradella*, Wals., was found to be one of the most common inhabitants of the cankers. Details are given of its bionomics and distribution ; it appeared to be of little economic importance, the larvae living entirely on the dead wood in cankers and other wounds of apple trees and being unlikely to disseminate the fungus, since they do not usually move from one lesion to another.

REINHARD (H. J.). **The Life History of** *Phyllophaga farcta* **and** *P. crassissima*.—*J. econ. Ent.* **35** no. 4 pp. 576–582, 8 refs. Menasha, Wis., 1942.

These laboratory studies of *Lachnosterna* (*Phyllophaga*) in Texas [*cf. R.A.E.*, A **29** 213 ; **30** 257] deal with *L.* (*P.*) *farcta*, Lec., a sluggish semidiurnal species in which the female lacks functional wings, and *L.* (*P.*) *crassissima*, Blanch., an active nocturnal form with fully developed wings in both sexes. The larvae of *L. farcta*, which is known to occur in 33 counties towards the north-west of the State, have caused widespread destruction of grasses and attacked vegetable crops, particularly garlic and onions [*cf.* **7** 393]. *L. crassissima* is widely distributed over the eastern half of the State, where it is one of the most frequently abundant species ; the larvae have been reported from strawberry beds, lawns and cotton fields without precise information concerning the injury produced, but its abundance indicates its potential importance.

The following is based on the author's summaries of the life-histories, recorded under laboratory conditions. The egg, larval and pupal stages of each species average 35, 435 and 27 days, and the life-cycle lasts two years. Overwintered beetles emerge and begin to oviposit during April. The larvae mature during autumn and remain quiescent until the following July, when pupation begins. Pupae are common during August and September. The adults remain in the pupal cells until the following spring.

MORRILL jr. (A. W.). **Notes on the Biology of** *Microbracon hebetor*.—*J. econ. Ent.* **35** no. 4 pp. 593–594. Menasha, Wis., 1942.

An account is given of the life-history of *Microbracon hebetor*, Say, based on laboratory studies carried out in the San Joaquin Valley, California, where its principal host is *Ephestia figulilella*, Gregson. It kills larvae of this moth hibernating in soil and under the bark of grape-vines and full-grown larvae that have left infested fruit in the field [*cf. R.A.E.*, A **23** 19], as well as the migrating larvae in stores of raisins and other dried fruit, where it sometimes destroys very large numbers. It also attacks *Plodia interpunctella*, Hb., but its economic importance in the control of either species has not been determined.

Adults were brought into the laboratory in January and allowed to mate, and each pair was provided with one living full-grown larva of *Ephestia* or *Plodia* per day. Rearing was continued for about a year, 14 generations being produced by using the females that emerged first from each brood. The females laid 2–358 eggs, 1–11 being deposited beneath or beside each paralysed larva. The larvae attached their mouth-parts to the host within a few hours of hatching and usually began to feed at once, and they pupated in cocoons near the remains of the host larvae. Emergence did not usually occur for several days after transformation to the adult stage, but mating and the paralysing of hosts by the females usually began within an hour of emergence. Unfertilised females produced only males. The egg, larval and pupal periods varied from

3·6, 15·3 and 11·8 days in November–January to 1·06, 4·4 and 4 days in July–August. Males and females that emerged in March and April lived 4–22 and 5–62 days, respectively, and the pre-oviposition, oviposition and post-oviposition periods of the females lasted 1–23, 1–55 and 0·44 days, eggs being laid at irregular intervals. The longer life of the females may be due to their feeding at points where they sting the host larvae ; males were not seen to take food, except occasionally, when they came upon the exudate at a freshly made puncture. Females paralysed many more larvae than were needed for oviposition and commonly oviposited on larvae paralysed by other females ; some oviposited without having fed on the larvae, and some fed without ovipositing afterwards.

Nearly all the parasites in raisin storages during winter were females, with the result that the proportion of males increased rapidly in spring ; in summer the sexes were present in about equal numbers.

Smith (G. L.), Scales (A. L.) & Fontenot (J. A.). **Effect of insecticidal Drift in small Plots upon Boll Weevil and Cotton Aphid.**—*J. econ. Ent.* **35** no. 4 pp. 594–595, 1 fig., 1 ref. Menasha, Wis., 1942.

In view of the recent tendency to reduce the size of plots when comparing insecticides against cotton insects, experiments were carried out in Louisiana in 1941 to determine the effect of the drift of dust from small plots of cotton to adjacent ones. Plots 97 ft. long and 35 ft. (10 rows) wide, arranged so that the control plots adjoined the treated ones on two or four sides, were dusted seven times between 18th July and 18th August with undiluted calcium arsenates containing 8·4 and 8·7 per cent. water-soluble arsenic pentoxide or the former with enough derris to give a rotenone content of 0·5 per cent. A screen cage was placed over a single plant near the centre of the first, third and fifth rows of each plot immediately after each application, boll weevils [*Anthonomus grandis*, Boh.] were released in the cages and their mortality was determined. It was found to be generally higher in the first row of the control plots than in the third and fifth rows and averaged 22·7 and 20·3 per cent. in the two plots adjoining treated ones on two sides, 35·1 and 33·8 in the two adjoining treated plots on four sides and 79·6, 50·3 and 67·6 per cent. in plots given the three different treatments. The average mortalities on similarly treated individual plants that were too widely separated for drift to have any effect were 17 per cent. on the control and 86, 85 and 84 per cent. for the three treatments.

Counts of the cotton Aphid [*Aphis gossypii*, Glov.] made before treatment began and at weekly intervals afterwards showed that the populations averaged 0·5 or less per sq. in. leaf surface before dusting and 12·5 per sq. in. in the four control plots and 22·7, 25·8 and 7·6 for the three treatments afterwards.

Smith (G. L.) & Fontenot (J. A.). **Notes on the Effect of Arsenicals upon the Cotton Aphid, Predators, and other Insects.**—*J. econ. Ent.* **35** no. 4 p. 596. Menasha, Wis., 1942.

Observations in cotton fields in Louisiana in 1941 showed that the cotton aphis [*Aphis gossypii*, Glov.] was scarce and Coccinellids abundant in fields that had not been dusted for the control of the boll weevil [*Anthonomus grandis*, Boh.], while the Aphid was very numerous in most of the dusted fields and there were few Coccinellids after 1st July. To find the effect of calcium arsenate dusts on these and other insects, a field at least half a mile from any dusted one was given five effective applications of calcium arsenate containing 10 per cent. Paris green between 23rd July and 18th August, and one of two that were near dusted fields containing severe Aphid infestations when the tests were begun was given three of a heavy calcium arsenate, containing a high percentage of water-soluble arsenic pentoxide, and clay (3 : 1) between 5th and 16th August,

while the other received four of calcium arsenate containing 1 per cent. free nicotine between 4th and 18th August. Parts of each field were left untreated, and counts of the insect populations were made before dusting began and at weekly intervals throughout the experimental period.

At the end of the treatment, the Aphid population was three and four times as great in dusted as in undusted parts of the first two fields, but only slightly greater in the third. Considerably fewer Coccinellids and Chrysopid larvae, but more boll weevils, were taken in dusted than in undusted areas, the reduction of Coccinellid larvae being greater than that of the adults. The numbers of Capsids were reduced in the first field, possibly owing to natural migration, but probably to the Paris green [*cf. R.A.E.*, A **26** 279]. The fact that weevils were more numerous in the dusted parts of all fields was probably due to migration in search of food, since dense populations destroyed most of the food in undusted areas during August, whereas there was an increase of squares and blooms in the dusted areas during the early part of the experimental period.

Noble (L. W.) & Hunt (W. T.). **Methods of rearing the Pink Bollworm Parasites** *Chelonus* **and** *Microbracon*.—*J. econ. Ent.* **35** no. 4 p. 597, 5 refs. Menasha, Wis., 1942.

The authors discuss the difficulty of rearing introduced parasites of *Platyedra* (*Pectinophora*) *gossypiella*, Saund., in the laboratory in Texas, largely owing to the short period during which the host is available. Studies of other possible hosts led to the selection of *Ephestia kuehniella*, Zell., which can be reared easily on dry food [*cf. R.A.E.*, A **22** 2] and gives satisfactory results with most species of *Chelonus* and *Microbracon*; it has been used since 1935 for rearing bollworm parasites of these genera, with outstanding results in the case of *Chelonus*.

For breeding *C. blackburni*, Cam., and *C. pectinophorae*, Cushm., the eggs of *Ephestia* are obtained in large numbers by adaptations of earlier methods [*cf.* **19** 118; **24** 330], scattered over a disk of moist absorbent paper pressed into a petri dish and exposed to the parasites in a cloth-covered cage for 24 hours. Although less satisfactory than *P. gossypiella*, *Ephestia* has been used for rearing *M. kirkpatricki*, Wlkn., *M. nigrorufum*, Cushm., and *M. mellitor*, Say. Since these Braconids will not oviposit in exposed larvae, a method was developed by which the hosts were paralysed by immersion in hot water (7 mins. at 120°F. for *Platyedra*; 1 min. at 116°F. for *Ephestia*) and separated from the parasites by a cloth, but in view of the danger of killing the host larvae, which would then decay before the parasite finished its development, this was superseded by one in which the larvae are confined between a heavy paper and a loosely woven cloth, bound in an embroidery hoop; all the parasite larvae attach their cocoons to the paper, which is removed and cleaned of the remains of the hosts as soon as the cocoons are formed, to reduce the danger of infestation by mites.

Smith (G. L.), Scales (A. L.) & Fontenot (J. A.). **Notes on the Control of Cotton Aphids.**—*J. econ. Ent.* **35** no. 4 pp. 598–599. Menasha, Wis., 1942.

The results are given of preliminary tests made in Louisiana in 1941 to determine the effect of nicotine sulphate and free nicotine in different concentrations and with different carriers in controlling *Aphis gossypii*, Glov., on cotton. Dusts containing 3 per cent. nicotine, prepared by mixing 40 per cent. nicotine sulphate solution with lime or a 10 per cent. free nicotine dust with lime, clay or tobacco dust, applied on 30th July in a heavily infested field resulted in about 66 per cent. control eight days after dusting in all cases but one (free nicotine and lime) in which a light dosage was used; counts made in the control plot only 10 rows from a dusted plot showed the same reduction, owing to

drifting [*cf. R.A.E.*, A **31** 198]. Since a considerable population of Aphids was still present on 13th August, the treatment was repeated on 15th August with an increased dosage, which resulted in much greater reduction in Aphids ; there was no reduction in the 30th row of the control plot. In another test, the dusts containing free nicotine gave excellent control when applied on 20th August at the rate of 13·5–15 lb. per acre, but that containing nicotine sulphate, applied at only 6·75 lb. per acre, was less effective. In a third, the nicotine sulphate dust, applied on 22nd August, gave almost complete control in a heavily infested field in three days and considerable reduction to the south of the dusted area, owing to drifting ; the dust was more effective when applied when dew was forming than earlier, when there was more drift.

In small-plot tests with dusts of nicotine sulphate with calcium arsenate, lime or tobacco dust and free nicotine with calcium arsenate, lime, clay or tobacco dust, applied on 27th August, dusts containing 3 per cent. nicotine, which were applied when there was no breeze and only a slow drift, were rather more effective than those containing only 2 per cent., which were applied when there was a light breeze and sharp drift from plot to plot. There was little difference in the effectiveness of the nicotine sulphate and free nicotine mixtures when used at the same concentration and with the same carriers. In each case the kill was higher on the centre leaves than on the top ones, owing to the fact that the dusts remained in the lower parts of the plants longer than in the tops when drift occurred, whereas in the middle of the 14 rows between the plots, the reduction in numbers, which though less than in the plots was considerable, was greater in the top leaves. The mixtures of free nicotine and the lighter carriers, such as lime and clay, seemed to kill more Aphids by drifting than the heavier dusts made from the liquid nicotine sulphate or tobacco dust. The same mixtures, applied to short sections of cotton rows between 26th August and 6th September, caused 90–97 per cent. reduction in population, the average reduction being 93·6 per cent. for dusts containing 2 per cent. nicotine and 95·6 for those containing 3 per cent.

Pollard (H. N.) & Thomas (W. A.). **Laboratory Tests on the Toxicity of Insecticides to the Strawberry Weevil.**—*J. econ. Ent.* **35** no. 4 pp. 599–600, 1 fig. Menasha, Wis., 1942.

An account is given of laboratory experiments on the control of adults of *Anthonomus signatus*, Say, which destroy the young fruit buds of strawberry by severing the stems after ovipositing in the buds, carried out at Chadbourn, North Carolina, where strawberries are grown commercially and the weevil is of considerable importance. Individual plants in cages were infested with ten active overwintered adults, treated with about 3 gm. dust and examined for dead weevils after 48 hours. In 1938, synthetic cryolite in clay or sulphur (21 per cent. sodium fluoaluminate) resulted in 75 and 70 per cent. mortality, as compared with 12 per cent. on untreated plants ; phenothiazine and clay (1 : 3), in one of two tests, calcium arsenate and tobacco dust (1 : 5) and synthetic cryolite in tobacco dust (21 per cent. Na_3AlF_6) gave significant control, but were much less effective. In 1939, a mixture of a material coated with an oil solution of pyrethrins and pyrophyllite (1 : 9), containing 0·2 per cent. total pyrethrins, gave 96 per cent. mortality and synthetic cryolite gave 72 per cent. when undiluted (83 per cent. Na_3AlF_6) and 36 per cent. when diluted with sulphur (42 per cent. Na_3AlF_6), as compared with 1 per cent. mortality on undusted plants. Sulphur, tobacco dust (0·5 per cent. nicotine), nicotine bentonite (3 per cent. nicotine) and calcium arsenate in sulphur (1 : 5) were not significantly effective.

A few tests made in 1938 with weevils of the summer generation were unsuccessful, as the newly emerged weevils did not feed on the dusted plants to any extent.

STONE (M. W.). **Effect of sterile and unsterile Foods on Rate of Development of Wireworms.**—*J. econ. Ent.* **35** no. 4 pp. 600–601, 1 ref. Menasha, Wis., 1942.

Larvae of *Melanotus longulus*, Lec., of the 1933 brood, that were fed on lima beans that had been boiled in water for about ten minutes in order to prevent sprouting (which causes considerable difficulty in rearing Elaterid larvae in cans, as the shoots force the lids off, resulting in the escape or desiccation of the larvae) developed more slowly and were smaller than others fed on moistened unsterilised wheat, and only 1 of 16 pupated (in 1938), as compared with 3 of 9 that were transferred from sterile to unsterile beans in 1936 and 54 of 75 on unsterile wheat.

Larvae of *Pheletes* (*Limonius*) *californicus*, Mannh., that hatched in 1937 and were fed on maize kernels, wheat kernels and lima beans and the same foods sterilised by boiling showed similar differences. The proportion pupating in 1937–40 was greatest on unsterile wheat, followed by unsterile maize and then unsterile lima beans ; 2 of 100 individuals fed on sterile lima beans pupated in 1938, when the remainder died, and a few of those in the other food groups completed development in 1939 and 1940.

It is concluded that boiling destroys certain vitamins in lima beans and wheat that are necessary for the growth of these two wireworms.

LINSLEY (E. G.) & MACLEOD (G. F.). **Ambrosia Beetles attacking deciduous Fruit Trees in California.**—*J. econ. Ent.* **35** no. 4 p. 601, 1 fig., 4 refs. Menasha, Wis., 1942.

During 1941, *Xyleborus dispar*, F., caused severe injury to nectarines in Siskiyou County, the attacks being confined to branches and frequently producing a girdling effect. In the summer and autumn, adults of *Pterocyclon* (*Monarthrum*) *dentigerum*, Lec., which has previously been reared from oak [*cf. R.A.E.*, A **18** 209], attacked the black walnut [*Juglans nigra*] root stock of a large number of Persian walnuts [*J. regia*] in Napa County. Their entrance burrows, which were conspicuous because of accumulations of boring frass, were perpendicular to the surface of the wood, and the galleries branched horizontally at a depth of 2–3 ins. and ran through the sapwood. Completed burrows were found in trees that had died during the previous season. At the same time, *Xylotrechus nauticus*, Mannh., was found attacking the black walnut root stock of living trees ; the eggs of this Cerambycid and of the Trogositid, *Temnochila virescens*, F., which is predacious on it, were very abundant. The majority of the infested trees looked healthy, but were found to be suffering from disease. Since the two Scolytids and the Cerambycid appear to attack unhealthy trees before their condition becomes apparent, they may be regarded as indicating an altered physiological condition in the trees.

KNOWLTON (G. F.). **Range Lizards as Insect Predators.**—*J. econ. Ent.* **35** no. 4 p. 602. Menasha, Wis., 1942.

In an area in Utah in which *Anabrus simplex*, Hald., was apparently very scarce as a result of successful control, the stomachs of 23 of 59 adults of *Sceloporus graciosus* collected among sagebrush (*Artemisia tridentata*) and rabbit-brush (*Chrysothamnus*) in May 1941 contained recognisable parts of third- or fourth-instar nymphs of the Tettigoniid. Since more than 500 examples of this lizard were present per acre, it is probably an important natural supplementary control factor. None of about 20 immature individuals had recently eaten *A. simplex*, probably on account of its large size. Similar results were

obtained with small numbers of *S. graciosus* in other districts, and two nymphs of *A. simplex* were obtained from examples of *Phrynosoma douglassii ornatissimum*.

Lists are given of the other insects found in the stomach contents of these lizards.

SWINGLE (M. C.) & PHILLIPS (A. M.). **An Insect Rearing Box with electric Barriers.**—*J. econ. Ent.* **35** no. 4 pp. 603–604, 2 figs., 1 ref. Menasha, Wis., 1942.

The cages for rearing insects already noticed [*R.A.E.*, A **29** 556] have been largely replaced since 1940 by the open shallow boxes here described, which can be mounted in series on a rack. Each box has electrically charged barriers on the inside upper edge to prevent the escape of crawling insects, the shock from a suitable voltage causing them to draw back quickly. Adaptations of the apparatus for various purposes and the voltages desirable for different species and stages of insects are discussed.

MACLEOD (G. F.) & JEPPSON (L. R.). **Some quantitative Studies of *Lygus* Injury to Alfalfa Plants.**—*J. econ. Ent.* **35** no. 4 pp. 604–605, 1 fig., 4 refs. Menasha, Wis., 1942.

Lucerne is one of the principal plants on which species of *Lygus*, which injure various agricultural crops, breed in many areas of California ; the two species encountered most frequently in lucerne fields are *L. hesperus*, Knight, which is the commoner in central California, and *L. elisus*, Van D. In 1939, experiments were begun to determine quantitatively the effects of the fe ding of *Lygus* on lucerne plants in terms of yield of hay. Plants were grown in water cultures for 16 weeks and then infested with 2, 4, 8 or 16 fifth-instar nymphs of *L. hesperus*, six days after the third cutting of hay ; they were allowed to grow without insects between the fourth and fifth cuttings and between the eighth and ninth, but infested during all the other growth periods. Details of the green and dry weight of the hay from each plant showed a normal steady increase in growth increment per day in each of the first three cuttings, a sharp decline in each case after infestation and a remarkable recovery during the period before the fifth cutting. Similar decreases in increment when the plants were infested and recoveries when they were not were shown for the later growth periods. Examination of sections indicated that injury to the vegetative growth consisted of a destruction of meristematic tissue at the growing tip. The age of the plants made little difference in the qualitative response to *Lygus* injury, but marked quantitative differences were apparent, decrease in growth being much more severe in early than in late stages. In general, both green and dry weights were reduced in direct proportion to the number of insects ; the ratio of green to dry weight indicated that the differences in proportion of moisture in injured and uninjured plants followed no consistent trend.

HIXSON (E.). **A new Pest of Snapdragon and Verbena.**—*J. econ. Ent.* **35** no. 4 pp. 605–606, 1 fig. Menasha, Wis., 1942.

The Tingid, *Teleonemia nigrina*, Champ., caused almost complete loss of plants of snapdragon [*Antirrhinum*] in a commercial greenhouse in Oklahoma in March 1940 and of native verbena grown as an ornamental plant in April 1941, and investigations have been carried out on its habits and control. It was reared on plants and cuttings of *Antirrhinum*, and the egg, nymphal and preoviposition periods lasted 7, 11½ and 3–4 days. The eggs were laid singly in the edge of the leaf or along the stem or in the petiole, and the nymphs began to feed on the leaves soon after hatching. The appearance of the injured leaves

is described. Wilting of the leaves and stems was common, and the plant usually died, a leaf at a time, from either the top or the bottom. The rate at which the plants wilted and turned white indicated that a toxic substance was deposited in the feeding puncture. A spray of Lethane 384 [50 per cent. butyl carbitol thiocyanate] in water (1 : 200) with potash fish-oil soap gave effective control on the greenhouse snapdragons ; it was syringed off the plants after one hour to prevent scorching. Nicotine, applied as a spray, dust or fumigant, derris dust and a commercial pyrethrum spray had proved ineffective. In 1941, superfine dusting sulphur tested against 10 adults had no apparent effect, but a Pyrocide dust containing 7·5 per cent. pyrethrins gave complete mortality of 162 adults and 17 fourth-instar nymphs.

BALZER (A. I.). **Life-history of the Corn Sap Beetle in Rice.**—*J. econ. Ent.* **35** no. 4 pp. 606–607, 1 ref. Menasha, Wis., 1942.

Carpophilus dimidiatus, F., which infests brown, milled and rough rice, rice bran and rice polish in storage in the southern United States, is seldom found in freshly milled grain that is clean and dry, but breeds readily in the bran and polish. In the rice-growing area on the coast of the Gulf of Mexico, where the average summer and winter temperatures are 80–90 and 50–60°F., respectively, and the atmospheric humidity 65–100 per cent. throughout the year, the moisture content of rice is 14·5 per cent. when it is milled and 12–14·5 per cent. when it is stored ; rice bran and polish are stored at a moisture content of 10–15 per cent., but rapidly turn rancid and become infested, and brewers' rice and rice screenings containing 14–15 per cent. moisture are occasionally attacked, especially when stored for a considerable period. The insect is almost universally present in accumulations of rice and rice products in mill machinery and under mills and warehouses.

Laboratory investigations carried out in 1937–40 in Texas showed that the winter may be passed in either the pupal or the adult stage ; the adult crawls during winter, but does not fly, becoming more active in early March, when oviposition begins. Pupae of the first generation have been found by 19th March. The female deposits 175–225 eggs at random in the food material. The larvae frequently hatch within 24 hours and mature in 10–11 days under optimum conditions, though those reared on cracked rice with a moisture content of 10 per cent. required 34 days and failed to pupate. The mature larvae burrow into the soil if possible or else pupate in the food material, in which case survival is low. The pupal stage may last only 7 days in summer or 140 days in winter. The females frequently begin to oviposit within 24 hours of emergence and continue until shortly before death, though they deposit most eggs when young. The adults live about 63 days in summer and up to 200 days when they overwinter. None of the insects completed its development in cracked rice with a moisture content of 10 per cent., a small proportion did so at moisture contents of 12·7 and 38 per cent., and the optimum moisture content for development was 15–33 per cent. The beetle was able to breed in putrefying food, but developed much more rapidly on sterilised food.

FLANDERS (S. E.). **An additional Observation on the Biology of** *Erynnia nitida*.—*J. econ. Ent.* **35** no. 4 p. 607. Menasha, Wis., 1942.

Recent observations confirmed the author's opinion that larvae of the Tachinid, *Erynnia nitida*, R.-D., that overwinter in adults of the elm leaf beetle [*Galerucella luteola*, Müll.] cannot complete their development until the beetles have begun to feed in spring [*R.A.E.*, A **29** 416]. Dissection of one of 22 overwintered beetles collected in California on 13th April 1942 showed that *Erynnia* had overwintered as a first-instar larva. The rest of the beetles were fed on fresh elm leaves in an outdoor cage, and on 4th May, a mature larva

of *Erynnia* was removed from one of them ; this pupated on the following day, and a female emerged on 21st May. Since oviposition by the overwintered beetles began on 3rd May, it appears that, under field conditions, adults of *E. nitida* emerge only when the spring generation of host larvae are available for oviposition.

BECKER (W. B.). *Prionus laticollis* (**Drury**) **in a subterranean wooden Duct for Telephone Cables.**—*J. econ. Ent.* **35** no. 4 p. 608. Menasha, Wis., 1942.

The failure of a telephone line in Massachusetts in September 1941 led to the discovery of three large larvae of *Prionus laticollis*, Dru., in one side of an underground wooden telephone duct made of southern pine that had been installed in 1930. The lead covering on the cable inside the duct had a hole chewed through it at the point where the wood was infested, as a result of which moisture had entered the cable and caused a short circuit. The duct had been treated with creosote before installation, but in the injured section, the infested side contained little or none of the preservative. Examination of the growth rings in the wood showed that it came from the centre of the tree, and therefore contained heartwood, which does not absorb creosote so well as sapwood ; in addition, leaching may have taken place, though the other side of the duct was well impregnated and showed no insect injury. The injury occurred at a depth of 3 ft. under lawn in sandy soil containing no roots of trees or shrubs, though a tree had been removed several years before.

A somewhat similar case, caused by larvae of the same species, occurred in a neighbouring town the year before, but in the vicinity of trees and shrubs.

MILLER (L. J.). **Peanut Leafspot and Leafhopper Control.**—*Bull. Virginia agric. Exp. Sta.* no. 338, 24 pp., 7 figs., 1 ref. Blacksburg, Va., 1942.

Serious injury and loss of crop is caused to ground-nuts in Virginia by leafspot (*Cercospora*) and *Empoasca fabae*, Harr., which occurs sporadically, and an account is given of investigations on their control, carried out in 1938–41 in view of the promising results obtained by Batten & Poos [*R.A.E.*, A **26** 609]. Satisfactory control of both was given by sprays of Bordeaux mixture, and increased crop yield resulted, but its use is considered impracticable for reasons stated. Sulphur alone was also effective against both pests, and dust mixtures containing copper compounds controlled leafspot but were more expensive though not more effective than sulphur. A dust of pyrethrum and sulphur (15 : 85) killed the leafhoppers more quickly than sulphur alone or Bordeaux mixture, but was less effective against leafspot and gave smaller increases in yield. It is concluded that profitable increases in yield can be obtained by making three or four applications of finely ground sulphur at the rate of 15 lb. per acre at fortnightly intervals, the first between 5th July and 1st August according to the varieties of ground-nut. If infestation by *E. fabae* is unexpectedly early, sulphur should be applied to check it, or, if the infestation is very heavy, a mixture of pyrethrum and sulphur at the rate of 15–20 lb. per acre should be used to effect a quick kill. Dusting with undiluted sulphur should be begun a week later. The sulphur must be sufficiently fine for at least 93 per cent. to pass a 325-mesh screen, and the dust should include a carrying or conditioning material to facilitate application. Mixtures of sulphur and lime or gypsum (1 : 3), broadcast by hand twice at the rate of 200 lb. per acre, controlled both pests and gave increased yield though the increases were less than those from sulphur alone. The lime mixture is recommended if the pH of the soil is below 5·8. Demonstration tests in which sulphur was applied three times showed that not only the yield of nuts and hay but also their quality was

improved. Ground-nuts dusted with sulphur mature 5–10 days later than undusted ones and can be left in the ground longer without serious loss through shedding.

MUNRO (J. A.) & TELFORD (H. S.). **The Sweet Clover Weevil.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **4** no. 6 pp. 21–22, 1 ref. Fargo, N. Dak., 1942.

Sitona cylindricollis, Fhs., was recorded on sweet clover [*Melilotus*] in Manitoba for the first time in 1939, and has since become widely distributed there. In 1941, it was reported from North Dakota and it has recently become common there and in Minnesota. Letters are quoted from A. V. Mitchener, who states that in Manitoba the damage is done largely to young plants struggling to become established in the ground, and the weevil is apparently responsible for many poor stands, and from T. L. Aamodt, who states that it destroyed many fields of seedling sweet clover during the spring and early summer of 1942 in north-western Minnesota. A. J. Thorsteinson stated that in Manitoba the adults overwinter among the stubble in the sweet-clover fields in which they have fed during the summer and oviposit from the latter part of May to early August; the larvae, which feed on the fine root hairs in the upper 6 ins. of soil, hatch in about a fortnight and, in cages, pupate in 38–60 days, giving rise to adults 7–12 days later. There is considerable overlapping of stages but only one generation in the year in North Dakota. The adults that survive the winter continue feeding well into the summer and begin to die off about mid-summer, by which time the adults of the following generation have begun to emerge [*cf. R.A.E.*, A **25** 779].

The defoliation is sometimes severe and reduces the carrying capacity of the pasture for livestock, the value of the plants for hay, the nectar production of the blossoms and the amount of plant material available as green manure. The only recommendation for control is to plough the sweet clover under as soon as the hay is cut, at latest before the third week of July, which is believed to kill the larvae and pupae in the soil, but this method is not applicable to roadsides or stony land.

THOMAS (C. A.). **Mushroom Insects: their Biology and Control.**—*Bull. Pa agric. Exp. Sta.* no. 419, [4+] 43 pp., 43 figs., 4 pp. refs. State College, Pa., 1942.

In this revised edition of an earlier bulletin [*R.A.E.*, A **20** 301], the number of major pests dealt with has been raised from 10 to 18 and the sections on prevention and control of infestation have been expanded to include newer methods. The additional major pests are the Phorids, *Megaselia flavinervis*, Mall., which is responsible for much of the mycelium injury in Pennsylvania, and *M. iroquoiana*, Mall., the Cecidomyiid, *Mycophila fungicola*, Felt, the larvae of which feed on mycelium in the manure, destroy the bases of mushroom stems and burrow just under the mushroom skin and have caused considerable injury in south-eastern Pennsylvania, Ohio, Indiana, and other mid-Western States, and the mites, *Rhizoglyphus phylloxerae*, Ril., which feeds on mycelium in newly planted spawn pieces, *Tyrophagus putrescentiae*, Schr. (*Tyroglyphus longior*, Gerv.), which has recently caused more injury than *Tyrophagus* (*Tyroglyphus*) *lintneri*, Osb. [*cf.* **26** 286], *Pigmeophorus americanus*, Banks, which sometimes occurs in such numbers as to retard the growth of the mycelium, and a species of *Tarsonemus* thought to be *T. floricolus*, C. & F., which has been increasing during the last few years and feeds on the surface of the stems, veils and caps, causing cessation of growth in small mushrooms.

Fumigants tested for use during the heating of the manure include a commercial combination of methyl bromide and carbon dioxide, which gave a good kill of pests in heating manure in a fumigation chamber but injured growing

mushrooms when applied in a mushroom house, and chloropicrin, which was effective in empty mushroom houses but had to be used at a rate of at least 6–8 oz. per 1,000 cu. ft. Nicotine and hydrocyanic acid gas (from calcium cyanide) are effective fumigants against flies of the genera *Megaselia* (*Aphiochaeta*) and *Sciara* during the growth of the crop. These flies can also be controlled by dusts of pyrethrum and nicotine, and the former has considerable residual action. Commercial fly sprays have shown no advantage over dusts and are more expensive.

Frost (S. W.). **Common Insect Larvae that attack the Apple in Pennsylvania.**—*Bull. Pa agric. Exp. Sta.* no. 420, 30 pp., 19 figs., 4 pp. refs. State College, Pa., 1942.

This bulletin is designed to assist growers to identify the principal chewing insects, mainly larvae, that damage apple in Pennsylvania, where 75 species are commonly found on this tree and some 25 are of economic importance. It includes a key to some 80 species based on easily distinguishable characters and feeding habits and two others based on the type of injury observed before 1st July and at harvest, when the insects concerned may no longer be present. Brief notes on the bionomics and feeding habits of several of the more important species and a chart showing the approximate periods of activity of eight species and those during which they can be controlled are also given.

Fletcher (F. W.) & Kenaga (E. E.). **Rearing Fabric Pests.**—*Soap* **18** no. 9 pp. 92–93, 101, 6 refs. New York, N.Y., 1942.

An account is given of investigations in the United States to evolve a suitable medium for rearing *Attagenus piceus*, Ol., as a test insect for use in experiments on repellents for fabric pests [*cf. R.A.E.*, A **31** 165]. The materials used comprised fish meal, maize meal, brewer's yeast, a proprietary dog food and woollen scraps in 10 different combinations, a list of which is given, and the criteria for assessing the results, which are shown in tables, were mortality, loss or gain in weight of the larvae, the proportion of larvae to complete their development, and the fertility of the adults. A mixture containing 72 per cent. fish meal, 25 per cent. maize meal, 3 per cent. brewer's yeast and 2 gm. woollen cloth [? per 100 cc.] gave the most satisfactory results. Woollen cloth seemed to be the least preferred of the five foods tested, since the larvae ate it only when the other foods in the culture were inadequate.

Porter (C. E.). **Breve nota acerca de un Pentatómido predator.** [A short Note on a predacious Pentatomid.]—*Bol. Dep. Sanid. veg.* **1** (1941) no. 2 pp. 35–36, 1 fig. Santiago, Chile, 1942.

Podisus (*Apateticus*) *nigrolimbatus*, Spin., is recorded as predacious on the larvae of the Lymantriid, *Orgyia* (*Notolophus*) *antiqua*, L., in Chile, and the adult of this Pentatomid is briefly described.

Durán M. (L.) & Cortés P. (R.). **La conchuela negra del olivo,** *Saissetia olcae* **Bern., en Chile.** [The Black Scale of Olive, *S. oleae*, in Chile.]—*Bol. Dep. Sanid. veg.* **1** (1941) no. 2 pp. 37–47, 1 graph, 16 refs. Santiago, Chile, 1942.

The authors briefly review the history, food-plants and distribution of *Saissetia oleae*, Bern., in Chile, where it occurs in almost all districts in which conditions permit its development and causes serious injury to olive, *Citrus* and avocado. Observations in the Province of Santiago showed that there are two generations a year. The adults of the generation produced in spring

begin to appear in November and oviposit from December to February. Some of their offspring become adult in autumn (April), while others overwinter as nymphs and become adult between mid-August and mid-September. The autumn adults oviposit, but it is not known to what extent the eggs survive the winter. It is stated by Quayle that a summer temperature of 80°F. inhibits the development of the Coccid at Lindsay, California, but no such effect is observed in Santiago, where the average maximum temperature in December, January and February is 29·1°C. [84·38°F.]. This may be due to relative humidity, which averages 60 per cent. in these months. Further to the north, at La Serena, where the relative humidity averages 76·5 per cent. and the maximum temperature 22·3°C. [72·14°F.] in December–February, each generation appears 1–2 months later than in Santiago.

All the predators and parasites of recognised value against *S. oleae* have been introduced into Chile, but the only one known to be established is *Scutellista cyanea*, Motsch. In 1940 and 1941, *Coccophagus yoshidae*, Nakay., which was not one of them and has not previously been recorded from Chile, was bred from the scale in various localities. It is usual in Chile to spray olive, *Citrus* and avocado in winter with lime-sulphur or a mineral oil. These sprays sometimes do not give good control, but they would not be more effective at other seasons, since settled nymphs or adults are always present at times when the less resistant crawlers occur.

CORTÉS P. (R.). **Sobre** *Perilitus stuardoi* **Porter.**—*Bol. Dep. Sanid. veg.* **1** (1941) no. 2 p. 48. Santiago, Chile, 1942.

Recent observations in Chile have shown that the Braconid, *Perilitus stuardoi*, Porter, parasitises not only *Eriopis connexa*, Germ., ab. *sedecimpustulata*, Latr., *Adalia bipunctata*, L., and *A. deficiens*, Muls., but also the introduced Coccinellid, *Cryptolaemus montrouzieri*, Muls. It is itself parasitised by *Spilochalcis porteri*, Brèth.

Principales plagas agrícolas producidas por insectos y otros animales que fueron objeto de consulta en el segundo semestre (Julio-Diciembre) de 1941. [The principal Injuries to Crops caused by Insects and other Animals that were reported in Chile from July to December 1941.]—*Bol. Dep. Sanid. veg.* **1** (1941) no. 2 pp. 57–62. Santiago, Chile, 1942.

This further list [*cf. R.A.E.*, A **30** 566] includes records of injurious insects and mites, with their food-plants and the localities in which they were observed, and of two Ichneumonid parasites, with their hosts.

MCKENZIE (H. L.). **Two new Species related to Red Scale (Homoptera : Coccoidea : Diaspididae).**—*Bull. Dep. Agric. Calif.* **31** no. 3 pp. 141–147, 2 figs., 2 refs. Sacramento, Calif., 1942.

The author describes *Aonidiella ensifera*, sp. n., from leaves of ivy (*Hedera helix*) in Chile, and *A. paucitatis*, sp. n., from leaves of *Carludovica palmata* in Panama, and gives a key to the species of the genus.

FREAR (D. E. H.). **Chemistry of Insecticides and Fungicides.**—Med. 8vo, viii+300 pp., 31 figs., many refs. New York, N.Y., D. van Nostrand Co., Inc., 1943. Price $4.

This book is based on the author's lectures in a graduate course on the chemistry of insecticides and fungicides at the Pennsylvania State College and contains information on the preparation, composition, properties and reactions of the various chemicals used in the control of insect pests and of fungous

diseases of plants. The first half deals with stomach poisons, contact insecticides and fumigants, and the remainder comprises chapters on fungicides, on wetting, spreading, emulsifying and adhesive agents, on commercial methods of removing spray deposits from fruit, together with a short discussion of the underlying chemical principles, and on the chemical analysis of large samples of insecticides and fungicides and of small quantities such as occur in spray residues on fruit. Extensive bibliographies of the various subjects dealt with are included.

Wilson (H. F.) & Bender (G. L.). **Rotenone Dispersion. A Comparison Study of two powdered Aluminium Silicates used as dispersing Agents for Rotenone.**—*Soap* **18** no. 10 pp. 101, 103. New York, N.Y., 1942.

The results are given of laboratory tests in which a kaolin clay with a particle size of 2 microns or less was compared with a sample of pyrophyllite, of somewhat similar chemical composition, containing particles 2–40 microns in size as a carrier for ground cubé. The electrostatic charge produced on the clay was not more than 500 volts and was reduced when 2 per cent. oil was added, whereas that on the pyrophyllite was approximately 7,000 volts and increased to 10,000 volts when oil was added. The clay did not disperse well and tended to flocculate on the upper surface of the leaves; the pyrophyllite showed a very fine evenly divided dispersion on the stems and upper and lower surfaces of the leaves. The dusts were made up to contain 0·1 per cent. rotenone and 2 per cent. of a conditioner and were applied to small plants, each of which had been infested with 20 Aphids in the fourth instar. When powdered conditioners were used, the results obtained were inconsistent, but with liquid conditioners, including mineral oil, the pyrophyllite dust gave significantly better control than the clay.

Keifer (H. H.). **Eriophyid Studies XII.**—*Bull. Dep. Agric. Calif.* **31** no. 3 pp. 117–129, 7 figs., 1 ref. Sacramento, Calif., 1942.

This part of a series [*cf. R.A.E.*, A **30** 555] includes an account of female dimorphism in *Oxypleurites aesculifoliae*, Keifer, which causes rusting of the leaves of buckeye [*Aesculus californica*] in California. Males and females typical of the genus are active during the growing season of the tree and produce additional primary mites and also, from the end of April or early May, females approximating more nearly to the genus *Phyllocoptes*. When fully fed, these deutogynes move from the leaves and enter crevices or other shelters in the previous season's wood, 6 ins. or more down the stem, where they become dormant and partially desiccated. The males and primogynes remain on the leaves, continuing to reproduce until early July, and die out when the leaves drop, in mid-July in the interior or towards the end of August on the coast. In late winter, the deutogynes become active, leave their hibernation quarters, penetrate beneath the outer scales of the buds when these swell in February and feed on the green tissue of the inner scales. When the early spring leaves develop, the deutogynes lay eggs from which hatch primary mites, including egg-laying females, indicating either predormancy fertilisation of the deutogynes or a deuterotokous reproductive capacity. There is a high mortality among the deutogynes, principally because they fail to find crevices.

The life-histories of a limited number of other mites on deciduous trees and shrubs, including the pear-leaf rust mite, *Epitrimerus pirifoliae*, Keifer, and the apple leaf mite, *Calepitrimerus baileyi*, Keifer, are similar to that of *O. aesculifoliae*; the deutogynes of *C. baileyi*, which also resemble the genus *Phyllocoptes*, hibernate round lateral buds on the fruit spurs. The typical pear-leaf rust mite occurs on pear leaves through much of the warmer weather

and then disappears, but rust mite deutogynes may be found during winter in large numbers in crevices at the base of the current growth and on the apex of the previous season's wood.

The author gives synopses to indicate the similarities and differences among Phyllocoptine mites (primary types, gall formers and deutogynes), an annotated list of the species occurring in California that are known to be deuterogynous and the results of experiments with the primary and secondary forms of *O. aesculifoliae*, which indicate that a certain proportion of deutogynes is produced by the first generation of primogynes, but that the deutogynes never reproduce during the season in which they develop.

PERSING (C. O.), BARNHART (C. S.), WORTHY (W. L.) & BOYCE (A. M.). **The Resistance of Citrus Thrips to Tartar Emetic Treatment in San Fernando Valley.**—*Calif. Citrogr.* **28** no. 1 pp. 5, 24–25, 2 figs., 4 refs. Los Angeles, Calif., 1942.

Spraying with tartar emetic and sugar, which has been used for the control of *Scirtothrips citri*, Moult., on all species of *Citrus* in California since 1939 with very satisfactory results [*cf. R.A.E.*, A **31** 58, etc.], gave very poor control in certain lemon groves over an area of about 300 acres in the San Fernando Valley in the late summer and autumn of 1941, though it had been effective in the same groves during spring and early summer. Investigations in 1942 showed that the failure of tartar emetic was not due to impurities in the materials, to chemical reaction with metals or foreign materials in the spray equipment, to the composition of the spray water or to the method of application, and that increasing the dosage per acre from 3 lb. each of tartar emetic and sugar to 12 lb. of each did not give satisfactory results. The substitution of various sugars and other materials for white sugar (sucrose) and of certain compounds closely related to it for tartar emetic was also ineffective. The possible development of a biological race of *S. citri* that is relatively resistant to tartar emetic was indicated by the results of detailed field and laboratory experiments to compare the susceptibility of thrips from various localities. The percentages surviving after 3 days of thrips from an untreated part of a grove in San Fernando and from another district were 32·2 and 0·01 when they were caged on the leaves of trees in the San Fernando grove that had just been treated with tartar emetic, 36·3 and 0 on detached leaves with a deposit of 5 mmg. each of tartar emetic and sucrose per sq. cm., 78·2 and 1 on leaves with 2·5 mmg. each per sq. cm. and 77·3 and 85·7 on untreated leaves. There was no significant difference in the mortality of thrips on leaves from the two areas. It has been reported that similar resistance appears to be developing in *S. citri* on orange trees in some groves in central California.

The results of limited investigations with sprays containing nicotine and sugar [*cf.* **27** 425], carried out in 1942 in areas in which tartar emetic is no longer satisfactory, indicated that nicotine sulphate was the most effective compound of those tested for the control of *S. citri*, but gave relatively poor results unless sugar was incorporated in the spray mixture. Sprays containing 1 U.S. quart nicotine sulphate and 8 lb. white sugar per 100 U.S. gals., applied with broom guns at the rate of about 2½ U.S. gals. per average mature lemon tree, or with a spray duster at 1 U.S. gal. per tree, gave a high initial kill and some protection for 3–4 weeks.

BERGER (E. W.). **Some unusual Hosts of Cottony Cushion-scale.**—*Florida Ent.* **25** no. 3 pp. 46–47. Gainesville, Fla., 1942.

Records of the cottony cushion-scale [*Icerya purchasi*, Mask.] on its less usual food-plants in Florida since 1915 include 5–6 slight attacks on wax myrtle (*Myrica cerifera*), one on quince, one on fig, two on goldenrod (*Solidago*), and none on

mulberry or pomegranate. Possible reasons for the low level of infestation on wax myrtle, which is abundant in the State and was very heavily infested in 1899, are discussed, and it is reported that specimens indicating a heavier infestation on this plant have recently been received from South Carolina.

BAERG (W. J.). **Rough-headed Corn Stalk-beetle.**—*Bull. Ark. agric. Exp. Sta.* no. 415, 22 pp., 9 figs., 15 refs. Fayetteville, Ark., 1942.

Descriptions are given of all stages of *Euetheola rugiceps*, Lec., together with an account of observations on its bionomics and control in Arkansas, where it is a serious pest of seedling maize. Following the development of a rearing technique in 1930 [*cf. R.A.E.*, A **20** 414], laboratory studies were made in 1931 [*cf. loc. cit.*] and 1933, and field observations were carried out in 11 counties in 1936–41. The life-history studies showed that this Dynastid has one generation a year and that females deposit up to about 100 eggs in the soil about the roots of plants. The egg stage, the three larval instars and the pupal stage averaged about 13, 14, 14, 36 and 16 days, respectively [*cf.* **24** 116], and total development 84·7 days. The adults overwinter. The larvae feed in the soil and are not injurious, but the adults attack maize slightly below the surface of the soil in May and early June [*cf.* **29** 2]. Rice is not severely attacked in Arkansas, but in 1935 serious injury was caused to strawberries in one county by adults that fed at the base of the plants, almost severing the leaf-stems. In addition the beetles feed on various grasses, rushes and sedges. Infestation occurs in a variety of habitats, principally on poorly drained soil [*cf.* **25** 623], and a high humus content is attractive to the ovipositing females. Control measures [*cf.* **21** 18; **27** 178; **29** 2, 3] include drainage and frequent cultivation, which kills many larvae and pupae. Maize should not be grown on land that is too wet for intensive cultivation.

MUNRO (J. A.) & TELFORD (H. S.). **Recent Progress in Wireworm Control.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **5** no. 2 pp. 7–11, 3 figs., 5 refs. Fargo, N. Dak., 1942.

A short account is given of the bionomics and control of *Corymbites* (*Ludius*) *aeripennis destructor*, Brown, which often causes serious damage to potato, cereals, sugar-beet and various garden plants in North Dakota. The injury caused to potato tubers is described; they are subject to attack over a much longer period than crops grown from seed, which are chiefly damaged soon after they germinate. The eggs are deposited at varying depths within the top six inches of soil, depending on moisture, temperature and depth of cultivation, between late April and early June and hatch in about three weeks. The larvae develop in the soil for about 4–5 years in the field, during the first two of which they do little damage, and pupate in earthen cells 3–5 inches below the surface during August. The adults emerge about three weeks later, but remain inactive and overwinter in the soil. On the approach of warm weather in spring, they leave the soil and feed on surface vegetation, but cause no apparent injury; oviposition begins in about two weeks and each female may deposit more than 250 eggs.

Control recommendations include clean summer fallow and suitable crop rotations [*cf. R.A.E.*, A **30** 520], and the planting of resistant varieties of potato [*cf.* **31** 60], as late as possible where infestation is known to occur and on low poorly drained soils rather than light or sandy ones. In preliminary experiments, potatos planted on infested soil on 6th and 22nd June 1942 suffered 40 and 15 per cent. wireworm injury, respectively, indicating that a considerable amount of early injury may be avoided by delayed planting, though extreme delays result in greatly decreased yields.

Downes (W.) & Andison (H.). **The Apple Sawfly *Hoplocampa testudinea* Klug on Vancouver Island, British Columbia.**—*Proc. ent. Soc. B.C.* **39** pp. 13–16, 6 refs. Vernon, B.C., 1942.

In June 1940, apples at Victoria, Vancouver Island, were found to be infested by larvae of *Hoplocampa testudinea*, Klug, which has not previously been observed in North America and was probably introduced in balled nursery stock. A survey showed that the sawfly was present over an area of 6 square miles. In view of its importance in Europe, the egg, larva and adults are briefly described, and an account of its bionomics is given, together with notes on control, both based partly on the literature [*cf. R.A.E.*, A **20** 579, etc.].

The fruit is attacked as soon as it begins to form, and the larvae are full-grown when it is 1 in. in diameter. Infested fruits fall to the ground about the time that the larvae leave, which they do through a large hole in the side. At Victoria, the percentage infestation ranged up to 50–60. In 1941, adults were first collected on 18th April, when they were fairly numerous, but early varieties of apple were in flower a week earlier, and it is probable that the sawflies began to appear at that time. The ratio of males to females was 4 : 1 on 18th April, and 2 : 1 on 23rd. The adults, which were active for three weeks, only visited trees in full bloom, apparently preferring flowers on the upper branches. Oviposition was not observed ; the position of the eggs is marked by a brown spot that is often partly hidden by pubescence, and the average and maximum numbers laid are stated by European workers to be 12–13 and 20–22, respectively. On leaving the fruit, the larvae enter the soil, overwinter in cocoons and pupate in the following spring. H. Velbinger stated that in Germany, diapause may last 9 or 21 months. The development of the larva in the cocoon probably depends on the amount of moisture in the environment at the time of spinning and the temperature during the first hibernation. Only three adults emerged from a considerable number of cocoons collected at Victoria, and this is attributed to insufficient moisture. Reproduction may be either bisexual or parthenogenetic. A partial second generation has occasionally been observed in England, but not in Germany.

A further survey in 1941 showed that the area infested had extended to the north and north-east, probably following the prevailing wind, and covered 16 square miles. Extermination was not considered possible, partly owing to shortage of labour. Nicotine sulphate (1 : 600) in a 1½ per cent. summer oil spray reduced the percentage infestation to 3·9 in one experiment and 5·2 in another, as compared with 80 on neighbouring unsprayed trees. As, however, the experiments were made on garden trees of many varieties, the results are regarded only as an indication. Lead arsenate, which was also included in the spray at the rate of 2 lb. per 40 gals., is not considered to have contributed to the control of the sawfly [but *cf.* **22** 425, 583]. In Germany, where nicotine with lead arsenate and lime-sulphur is stated to have proved ineffective, the best control was given by a strong solution of quassia extract applied at petal-fall.

Hoy (B.). **The Advance of the Codling Moth in British Columbia.**—*Proc. ent. Soc. B.C.* **39** pp. 16–19. Vernon, B.C., 1942.

An account is given of the progress of infestation by *Cydia* (*Carpocapsa*) *pomonella*, L., and the measures employed to check it in British Columbia since 1915, when it first became of importance, until the present time, when it is the chief factor limiting apple production throughout the inland apple-growing areas of the south. Until the end of 1925, infested areas were placed under quarantine and control measures enforced in them. The most important of these were the use of lead-arsenate sprays and bands, the inspection of orchards, the destruction of infested fruit, and the inspection and treatment by superheating of refrigerator cars [*R.A.E.*, A **9** 563, 582 ; **10** 578] ; in 1918, all

apples in one area were destroyed before they were ripe. Some local successes were obtained by this means, and despite the general lifting of quarantines in 1926, when infestations in the southern part of the Okanagan Valley were so widespread and numerous that there was little hope of complete eradication, officially organised spraying and banding was still carried out in some districts, in one of which eradication was secured.

MARSHALL (J.). **Effect of Lime and Lime-sulphur on the larvicidal Value of Cryolite.**—*Proc. ent. Soc. B. C.* **39** pp. 19–20, 4 refs. Vernon, B.C., 1942.

Although it is generally believed that cryolite is chemically incompatible with lime or lime-sulphur in a spray, no evidence has been presented that the lime reduces the toxicity of the cryolite to insects. In field experiments in British Columbia in 1939, cryolite sprays containing casein and lime appeared to be more effective against larvae of the codling moth [*Cydia pomonella*, L.] than similar sprays containing blood albumin or ammonium oleate, and further experiments were therefore made on apple in 1940 and 1941 in which mixtures containing $3\frac{3}{4}$ lb. natural cryolite, $\frac{1}{2}$ oz. lactic casein and $\frac{1}{4}$, 1 or 4 lb. hydrated lime in 100 gals. water were compared in cover sprays with $3\frac{3}{4}$ lb. lead arsenate, $\frac{1}{2}$ oz. casein and $\frac{1}{4}$ oz. lime in 100 gals. The cryolite spray was at least as effective as the lead arsenate when it contained $\frac{1}{4}$ oz. lime, less effective in one year, but not in the other, when it contained 1 lb., and considerably less effective when it contained 4 lb. A similar cryolite spray containing only 1 oz. lime was also used in 1940 and was slightly less effective than that containing 4 oz. In a laboratory experiment in which newly-hatched larvae were allowed to attack apples that had been sprayed with the cryolite spray containing $\frac{1}{4}$ lb. lime, with or without the addition of lime-sulphur or elemental sulphur at rates giving equivalent concentrations of sulphur (1·6 gals. and $4\frac{1}{2}$ lb. per 100 gals., respectively), the percentages of fruits that were superficially damaged and that contained larvae were 14 and 29 for the cryolite spray alone, 13 and 35 for the spray with sulphur, and 6 and 60 for the spray with lime-sulphur, as compared with 1 and 70 for unsprayed apples.

SPENCER (G. J.). **A Note on *Laelius* sp., a Parasite of the Carpet Beetle *Anthrenus scrophulariae* (L.) (Hymenoptera, Bethylidae).**—*Proc. ent. Soc. B. C.* **39** pp. 21–22. Vernon, B.C. 1942.

Among floor sweepings containing living larvae and the remains of adults of *Anthrenus scrophulariae*, L., received from a town in southern British Columbia on 3rd August 1941, were a number of larval skins in which the Dermestids had pupated, and three that each contained four silken pupal cases embedded in silk and lying in the same axis as the skin. Two adult Hymenoptera, one partly enveloped in the silk, were also present and were found by O. Peck to agree closely with the description of *Laelius occidentalis*, Whittaker, though they were lighter in colour. Nothing is known of the bionomics of this Bethylid, but other members of the genus are external parasites of the larvae of Dermestids. As, however, the larval skins of *A. scrophulariae* were not shrivelled or punctured, the author suggests that the host was attacked in the pupal stage.

SPENCER (G. J.). **Insects and other Arthropods in Buildings in British Columbia.**—*Proc. ent. Soc. B. C.* **39** pp. 23–29. Vernon, B.C., 1942.

Notes are given on a large number of insects and other Arthropods found in dwellings and received or recorded at the University of British Columbia during the last ten years. The pests of food-stuffs that are common in mills, factories and warehouses are omitted.

OLDS (H. F.). **The Results of further Work done on the Control of Grain Mites in British Columbia.**—*Proc. ent. Soc. B. C.* **39** pp. 29–32. Vernon, B.C., 1942.

The importance of mites, which are normally not serious pests of stored grain in Canada, has increased under recent conditions, which necessitate the placing of large quantities of grain in temporary storage, where the cost of turning is high; in addition, harvesting conditions have resulted in the presence of a certain amount of damp grain and this must be turned frequently to avoid heating. Grain containing more than 14 per cent. moisture is likely to become heavily infested unless it is stored in separate bins and turned at regular intervals. In inspecting bins, samples should be taken both from the top and from the bottom. If infestation is slight, mites are often present only for a few feet down from the top and up from the bottom of the grain, and the moisture content of the grain is usually normal. In an experiment in which slightly infested wheat was drawn off from a bin 26 ft. wide and 100 ft. deep and placed in another, no mites were found after the removal of the first few tons until the surface of the grain coned in, which it did when 40 ft. from the bottom. There was a decrease in the number of mites at the surface of the newly-filled bin, indicating that some had been destroyed during the transfer, but enough survived to build up an infestation if conditions became favourable for it. It is suggested that under these conditions, wheat from the top and bottom of an infested bin should be cleaned and dried before being replaced in another bin.

Chloropicrin is a useful fumigant for grain at very low temperatures in bins that are reasonably gas-tight, but it can be used only for surface fumigation in large bins, since it does not penetrate more than 25–30 ft. during an exposure of 36 hours. In an experiment by Stillman, methyl bromide used at the rate of 1 lb. per 1,000 cu. ft. penetrated 90 ft. in 36 hours and gave very satisfactory control of the mites. The optimum temperature for the use of methyl bromide is about 65°F., but it gives good results at slightly lower temperatures. Grain placed in bins during the summer, when its temperature is about 55–60°F., does not vary in temperature by more than 2–3°F. under normal storage conditions throughout the year, but the temperature of grain placed in storage during winter may be as low as 30–35°F. and so too low for fumigation with methyl bromide. The flavour of flour milled from grain treated with this material is unlikely to be impaired, as whole grains absorb only minor quantities [*cf. R.A.E.*, A **29** 444]. The risks associated with its use and the precautions to be taken are enumerated; and the cost of application, which is rather high under present conditions, is briefly discussed.

WALLEY (G. S.). **A new *Olesicampe* Parasite of *Pikonema* Sawflies (Hymenoptera, Ichneumonidae).**—*Canad. Ent.* **74** no. 10 pp. 193–194. Guelph, Ont., 1942.

The new species, which is described from adults of both sexes, is *Olesicampe pikonemae*; it was reared from *Pikonema alaskensis*, Rohw., and *P. dimmocki*, Cress., collected in various localities in eastern Canada and in British Columbia.

MORRIS (R. F.). **Preliminary Notes on the natural Control of the European Spruce Sawfly by small Mammals.**—*Canad. Ent.* **74** no. 11 pp. 197–202, 9 refs. Guelph, Ont., 1942.

The following is based on the author's summary. The importance of small mammals in the natural control of forest insect pests has not been generally appreciated. In areas in eastern Canada in which cocoons of the spruce sawfly, *Gilpinia hercyniae*, Htg., have been numerous for some years, 40–50 per cent. are commonly destroyed by small forest mammals. The cinereous shrew (*Sorex cinereus*), the red-backed vole (*Clethrionomys gapperi ochraceus*)

and white-footed mice (*Peromyscus* spp.) are the most abundant mammals in the coniferous forests of this region, the shrew being the most effective in sawfly control. Population studies show a considerable seasonal fluctuation in the population of small mammals. The character of the site has an important influence on the abundance of shrews and rodents, dry sites with abundant protective ground cover being preferred, and little insect control by mammals can be expected in clean stands in which brushwood has been burnt or otherwise destroyed. The activity of small mammals in searching for sawfly cocoons is greatest in autumn, when the mammal population is high and the hoarding of cocoons is a common practice. Their searching ability is remarkable, and the shrews, but not the rodents, can recognise sound cocoons before they open them.

HOPPING (G. R.). **Apparent negative Geotropism in the Douglas Fir Bark Beetle.**—*Canad. Ent.* **74** no. 11 p. 205. Guelph, Ont., 1942.

A small-scale experiment carried out in British Columbia to determine whether the habit of the Douglas fir bark-beetle, *Dendroctonus pseudotsugae*, Hopk., of burrowing upwards in the tree [*Pseudotsuga taxifolia*] from the entrance hole is due to negative geotropism or to some structural or physiological factor in the tree, in which three trees were felled and allowed to rest at different angles, all with the crown of the tree lower than the base, showed that, whereas all beetles in a standing tree burrowed towards the crown, in the felled ones a majority that increased with the steepness of the slope burrowed upwards towards the base. Since all galleries followed the general direction of the grain either upward or downward, it is concluded that the beetles tend to follow the structure of the wood, but also show a rather definite negative geotropic response.

FREEMAN (T. N.). **A new Species of *Pseudexentera* from Apple, with Notes on allied Species (Olethreutidae, Lepidoptera).**—*Canad. Ent.* **74** no. 11 pp. 212–215, 18 figs. Guelph, Ont., 1942.

The author describes the adults of both sexes of *Pseudexentera mali*, sp. n., which was found breeding on wild apple in the neighbourhood of Ottawa and on apple trees in orchards in New York. Since it was commonly observed flying round hawthorn (*Crataegus* sp.) in the Ottawa district, this is probably another food-plant. This species, *P. improbana*, Wlk., which develops on oak, and *P. oregonana*, Wlsm., which feeds on poplar, all fly together in the Ottawa region, and characters by which the adults can be separated are given. They emerge and fly in early spring just before the leaf buds have opened, and the females oviposit on the terminal twigs. The larvae become full-grown in about two weeks and enter the soil, where they spin cocoons and aestivate until they pupate in early autumn. Brief descriptions are given of the eggs and larvae of the three species.

HOLDAWAY (F. G.) & NISHIDA (T.). **Insects associated with freshly threshed dry Beans.**—*Proc. Hawaii. ent. Soc.* **11** no. 2 pp. 167–168. Honolulu, 1942.

Adults of *Bruchus maculatus*, F. (*quadrimaculatus*, F.) to the number of 115 as well as 3 of *B.* (*Callosobruchus*) *chinensis*, L., emerged from a sample of 436 threshed cowpea seeds harvested at the end of September 1941 in Hawaii. A sample of 1½ lb. threshings contained 19 individuals of the former and two of the latter, in addition to other insects. These observations show that initial infestation of cowpeas by *B. maculatus* occurs in the field before harvest. No insects were recovered in similar experiments with lima beans.

Schmidt (C. T.). **Ear Worm Control in Sweet Corn.**—*Proc. Hawaii. ent. Soc.* **11** no. 2 pp. 195–197, 1 fig., 1 ref. Honolulu, 1942.

In view of the good control of *Heliothis armigera*, Hb., on maize obtained in the United States by injecting mineral oils alone or with the addition of an insecticide into the ears [*cf. R.A.E.*, A **30** 267, etc.], this method was tested on sweet maize in Hawaii, where *H. armigera* is a serious pest. A highly refined mineral oil with a viscosity of 145–155 seconds Saybolt at 100°F. was applied alone or with the addition of a derris extract stated by the manufacturer to contain 5 per cent. rotenone in a total of 20 per cent. extractives dissolved in camphor oil, which was used at the rate of 36 cc. per U.S. gal. oil, giving 0·05 per cent. rotenone in the mixture. The oil was applied on 26th February 1941 by means of a pressure oiler calibrated to eject 0·8 cc. at a time and was placed on the silk as near the tip as possible. Two weeks later, the percentages of tips damaged were 10·6 when the oil was used alone, 6·2 when derris extract was included, and 60·8 on untreated plants. The only deleterious effect noted was a temporary flavouring of the tips by the camphor oil, but this could not be detected after three days. A single treatment of the field may be sufficient in a stand of uniform maturity, but if the development of some plants is retarded, these should be treated at a later date. Although the oil should not be applied until the wilting of the silks indicates that pollination has taken place [**30** 268], application should not then be too long delayed, since the oil, which kills the larvae by contact, is more effective against the early instars. There was a tendency for the larger larvae to move away from treated ears, probably because the oil rendered the silks unpalatable.

Holdaway (F. G.) & Look (W. C.). **Insects of the Garden Bean in Hawaii.**—*Proc. Hawaii. ent. Soc.* **11** no. 2 pp. 249–260, 16 refs. Honolulu, 1942.

The observations on which these notes are based were made chiefly on Oahu in 1938–40. The injurious insects dealt with are placed in three groups according to their importance, and information is given on their habits, local distribution and alternative food-plants. Of the major pests [*cf. R.A.E*, A. **29** 650], *Adoretus sinicus*, Burm., appears to be least injurious to beans in very dry and relatively moist districts and causes most damage during the summer ; activity is probably influenced more by seasonal differences in moisture, which are generally fairly marked, than by differences in temperature, which are slight. The adults attack the leaves and sometimes the buds and are active by night, sheltering in the soil or under dead leaves by day. When abundant, they may skeletonise the plants. Adults and nymphs of *Empoasca solana*, DeLong, feed on the lower surfaces of the leaves, causing hopperburn [*cf.* **24** 504]. In two localities, in both of which it is abundant, as many as 28 and 11 Jassids per leaflet were recorded ; in another, in which it is abundant on castor [*Ricinus communis*], it occurs only occasionally on garden beans. *Pycnoderes quadrimaculatus*, Guér., is most abundant in hot dry areas, in one of which as many as 45 examples of this Capsid were recorded per leaflet on plants that were two months old. It feeds on the lower surfaces of the leaves and causes a light stippling of the upper surface, resembling that due to *Tetranychus* sp. The adults and nymphs are destroyed by the Reduviid, *Zelus renardi*, Kol., and a parasitic fungus, *Entomophthora sphaerosperma*, has been recorded from individuals on cabbage and cucurbits but not on beans. Large colonies of *Aphis medicaginis*, Koch, often infest the leaves, stems and pods, killing plants of all ages. Prior to the winter of 1940–41, a species of *Trialeurodes* provisionally determined as *T. vaporariorum*, Westw., was regarded as a minor pest, but it then became abundant in several hot dry regions. Infestation was heavy between January and June 1942, and resulted in serious losses in March and April. Infestation by mites is especially high during the hot dry season and in arid districts.

Tetranychus sp. occurs on the lower surface of the leaves associated with a fine web. The older leaves are often attacked, and as a result of feeding the upper surfaces become stippled with white spots ; heavily infested leaves turn yellow and fall. *Tarsonemus* (*Hemitarsonemus*) *latus*, Banks, generally attacks the young leaves, causing them to become distorted and crinkled. The stems are also attacked, and where infestation is severe, the growth of the whole plant is stunted.

Maruca testulalis, Geyer, was first observed in Hawaii on green peas and lima beans in 1922. The adults of this Pyralid are nocturnal, sheltering among the lower leaves of the plants during the day. The young larvae generally bore in the pods, but also attack the flowers, foliage and stems. Pods damaged when they are young fall or are deformed, and those attacked at a later stage are rendered unmarketable by the presence of holes and excrement. As yet, severe damage has occurred only locally. Lima beans are more susceptible to attack than garden beans, and hyacinth beans [*Dolichos*] are also infested. The larvae are preyed upon by adults of the Eumenid, *Pachodynerus nasidens*, Latr., and parasitised by the Ichneumonid, *Cremastus flavoorbitalis*, Cam. *Plusia* (*Autographa*) *chalcites*, Esp., which is parasitised by the Encyrtid, *Litomastix floridana*, Ashm., *Cosmolyce boetica*, L., and *Dacus cucurbitae*, Coq., are occasionally harmful. Lists of minor pests, beneficial insects and incidental insects are appended.

GREGORY (J. N.). **Investigations on the Treatment of solid Timber with Boric Acid to render it immune from the Attack of the Powder Post Borer (*Lyctus brunneus* Stephens). I.—Laboratory and preliminary Investigations.**—*J. Coun. sci. industr. Res. Aust.* **15** no. 3 pp. 233–247, 6 graphs, 3 refs. Melbourne, 1942.

Since certain Australian commercial timbers, including red tulip oak (*Tarrietia argyrodendron* var. *peralata*), yellow carabeen (*Sloanea woollsii*) and white birch (*Schizomeria ovata*), are characterised by deep bands of sapwood and intermediate wood, which usually contain relatively large amounts of starch and are therefore very susceptible to attack by *Lyctus brunneus*, Steph., investigations were carried out to determine the conditions required to impregnate boards of intermediate wood and sapwood of these three species with boric acid by diffusion into the green timber [*cf. R.A.E.*, A **27** 509]. When the temperature of the solution was kept just under boiling point, to prevent excessive evaporation and obtain the maximum rate of diffusion, immersion for 16 hours in solutions containing 4, 8 or 16 per cent. boric acid or for 8 hours in a 16 per cent. solution gave more than sufficient concentration of acid through blocks of red tulip oak 3 ins. by 5 ins. in section ; the other two timbers absorbed more boric acid and seemed to be easier to penetrate. Charts are given showing the relation between length of treatment, concentration of solution and depth of timber rendered immune, and the commercial application of the treatment, including cost, the equipment required and the necessity for checking the concentration of the solution and in the treated timber from time to time are discussed. Methods of determining the concentration of boric acid in solutions and of boric acid and borates in timber are appended.

Insect Pests.—*Agric. Gaz. N.S.W.* **53** pts. 9–10 pp. 429–432, 462–466, 10 figs. Sydney, 1942.

The first of these parts of a series [*cf. R.A.E.*, A **31** 184] was issued in September and comprises notes on measures to be taken at that season for the control of various common pests of vegetables and fruit trees in New South Wales. The second includes a section on pests of cucurbits, of which the most important are *Aulacophora* (*Ceratia*) *hilaris*, Boisd. [*cf.* **30** 498], *Epilachna*

vigintioctopunctata, F., and *Aphis gossypii*, Glov. This Aphid can be controlled by a spray of 1 fl. oz. nicotine sulphate, 6½ fl. oz. white oil emulsion and 4 gals. water, applied as soon as infestation is observed and repeated as necessary. Young plants can be protected against *E. vigintioctopunctata* [*cf.* **28** 513] by two applications at an interval of 10 days of a dust of pyrethrum powder and kaolin or flour (1 : 4).

BOURIQUET (G.). **Contribution à l'étude des altérations de la vanille préparée (moisissures et mite).**—*Bull. Acad. malgache* (N. S.) **24** (1941) pp. 65–80, 5 pls. (4 col. fldg.), 1 fig., 28 refs. Tananarive, 1942.

In the final section of this paper, the author reviews the literature on the occurrence of *Tyroglyphus* sp. on the stored capsules of vanilla [*cf. R.A.E.*, A **7** 193] and states that mites of this genus were observed on packed capsules from Antalaha, Madagascar. They were killed by immersing the capsules for 5 minutes in water at 63°C. [145·4°F.], but survived for several hours in water at room temperature. The resistance of the capsules to fungous infection is reduced by hot-water treatment, and it is suggested that this might be prevented by substituting for water a saturated solution of vanillin, which is shown in an earlier section to inhibit development of fungi. This may not prove the best method of control, however, since there is some local evidence that infestation is dependent on fermentation at the point of removal of the capsules from the vines. Control of this ferment might prevent infestation by the mites, and could be achieved by sealing the wound on the capsule with paraffin wax.

MOUTIA (L. A.). **La teneur en humidité du maïs en grain en relation avec divers états hygrométriques de l'air.**—*Rev. agric. Maurice* **21** no. 3 pp. 122–126. Port Louis, Mauritius, 1942.

In the course of experiments in Mauritius to ascertain the effect on uncrushed maize of various degrees of atmospheric humidity, an infestation by *Calandra oryzae*, L., of bagged maize in a granary was observed. The percentage of grains infested averaged 4 on 30th April 1941 and 17 on 8th April 1942; it was greatest in the bags at the top and edges of the rows. The average moisture content of the grain during this period fell from 11·6 to 10·2 per cent., though the relative humidity rose from 57 to 75 per cent. In the laboratory, it was found that *C. oryzae* could live normally in maize with a moisture content of only 8·5 per cent. [*cf. R.A.E.*, A **30** 218], so that drying the grain to this extent is no safeguard against attack.

MOUTIA (A.). **Notes préliminaires sur la cochenille de la canne à sucre *Aulacaspis tegalensis* Zehnt.**—*Rev. agric. Maurice* **21** no. 3 pp. 132–133. Port Louis, Mauritius, 1942.

In the course of investigations on *Chionaspis* (*Aulacaspis*) *tegalensis*, Zehnt., which is a serious pest of sugar-cane in some parts of Mauritius, the canes in one half of an experimental field, in which none of the Coccids examined were parasitised, were stripped of dried leaves. A month later all the Coccids on the stripped canes were parasitised, but only 2·6 per cent. on the others. Predacious Coccinellids were very abundant on the stripped canes and rare on the unstripped ones.

OOSTHUIZEN (M. J.) & SCHMIDT (U. W.). **The Toxicity of Carbon Dioxide to the Cowpea Weevil.**—*J. ent. Soc. sthrn Afr.* **5** pp. 99–110, 3 graphs, 11 refs. Pretoria, 1942.

The experiments described were carried out in view of the conflicting results recorded in the literature, which is reviewed, as to the toxicity of carbon dioxide

to pests of stored products, chiefly insects infesting grain [*cf. R.A.E.*, A **5** 128 ; **9** 521 ; **29** 380] and the lack of information as to its effect on the immature stages of these pests [*cf.* **7** 94]. In the first series of tests, eggs, young and full-grown larvae (1 and 2 weeks old, respectively), pupae and adults of *Bruchus* (*Callosobruchus*) *chinensis*, L., in stored cowpeas were exposed in 6-litre flasks and the concentration of gas was determined at the end of the exposure period. Of the immature stages, the eggs were the least and the full-grown larvae the most resistant. Complete mortality of eggs was given by exposure to concentrations of 48·0, 37·5 and 18·7 per cent. for 4, 5 or 8 days, respectively, though not by one of 4 days to 64·0 per cent., and of week-old larvae by concentrations of 52·7, 55·5 and 22·0 per cent. for 4, 5 and 9 days, respectively, whereas a concentration of 29·0 per cent. for 17 days or 25·2 per cent. for 19 days was required to destroy all the full-grown larvae and pupae. The pupae appeared to be more susceptible than the full-grown larvae, but this is thought to be due to the fact that some transformed to adults during exposure to sub-lethal concentrations and that many of the adults, which are much more susceptible, died before they could escape from the seeds. The effectiveness of the gas appeared to be greater at high than at low temperatures. When adults were exposed to the gas, they became very active for a short time, after which it exerted an anaesthetic effect. Although apparently complete mortality was obtained from each exposure tested, many of the adults revived after the shorter exposures ; none did so when the concentration was 31 per cent. and the exposure 90 hours. Larval development appeared to be retarded by sub-lethal concentrations of carbon dioxide to an extent proportional to the length of exposure. When 10 pairs of adults from each of two series of pupae that had been exposed to mean concentrations of 57·4 and 56·1 per cent. for 7 and 10 days, respectively, were enclosed with cowpeas, the females deposited a normal number of eggs, but 5 of those that had been exposed for 10 days laid infertile ones ; it is not known which sex was harmed by the treatment.

The effect of carbon dioxide on the viability of cowpea seeds was tested by exposing seeds with moisture contents of 9, 16·5, 20·0 and 21·5 per cent. in 6-litre flasks to which 3 cc. carbon tetrachloride was added to reduce respiration and prevent the growth of moulds. Carbon tetrachloride was added to the control seeds at the rate of 5 cc. per flask ; it was found that although this prevented the development of moulds, it did not inhibit respiration. The viability of seeds containing 20·0 and 21·5 per cent. moisture was greater after exposure to high concentrations of carbon dioxide than to the low ones that developed in the control flasks, and that of seeds with a moisture content of 9 per cent. that were exposed to concentrations of 18·7 or 25·2 per cent. for 31 days was unaffected.

In further experiments, the effect of fumigating cowpeas in old and new galvanised iron tanks, each 6 ft. high and 3 ft. in diameter and with a calculated air space when filled with seed of 16 cu. ft., was investigated. Cages containing the test insects were placed at the bottom, in the centre and on the surface of the seeds in the bins ; all the immature stages were included in the tests with the new bins, but fully-grown larvae were omitted from the old ones. Carbon dioxide was introduced at the bottom of each tank until a burning spirit lamp on the surface of the seeds was extinguished, the amount required being 1¼–1½ lb. ; the tanks were then made as gas-tight as possible and after exposure the insects were removed and kept at 25°C. [77°F.] until development was completed. The percentages of carbon dioxide lost from the two old bins were 40 and 98 after 14 days, whereas those from the two new ones were only 25 after 14 days in one case and 26 after 21 in the other. After a time, the distribution of the gas throughout the bins was fairly uniform. In the old bins, there was considerable survival among pupae after fumigation under all conditions. Survival after exposure for 14 days was greater at 60°F. than at 75°F., and this is attributed to the higher temperature resulting in the emergence of

more adults, which died before they could escape from the seeds. Complete mortality of eggs and young larvae was obtained in some instances. In the new bins, exposure for 21 days gave complete mortality of all the immature stages, and the author concludes that for effective fumigation with this gas a fairly high concentration and a long exposure are essential.

Nel (R. I.). **Biological Control of the Codling Moth in South Africa.**—*J. ent. Soc. sthrn Afr.* **5** pp. 118–137, 25 refs. Pretoria, 1942.

In view of the increasing difficulty and cost of controlling *Cydia* (*Carpocapsa*) *pomonella*, L., on pears and apples in South Africa by sprays, up to 17 applications of which have to be made in some cases, the possibility is discussed of utilising biological control. Records of indigenous parasites and predators are reviewed from the literature [*cf. R.A.E.*, A **8** 284], and attempts to introduce foreign parasites described [*cf.* **12** 345]. The only one that became established was *Ascogaster quadridentata*, Wesm., from Italy, which is present in several localities in western Cape Province. In 1942, small lots of *Ephialtes caudatus*, Ratz., and *Cryptus sexannulatus*, Grav., were imported from Canada, where these Ichneumonids had been received from France [**30** 112]. They are being reared in the laboratory.

Recent observations have shown that the natural enemies present are *Trichogramma luteum*, Gir., which parasitises a high percentage of the eggs late in the season and is widespread, *A. quadridentata*, which oviposits in the egg and develops in the larva, *Cremastus* sp., which parasitises the larvae, *Pimpla heliophila*, Cam., which oviposits in the pupae or the larvae in their cocoons and is widely distributed, *Cryptus* sp., the larvae of which feed externally on the pupae and which has been found in only one orchard, *Anthrocephalus* sp., which occurs in association with *P. heliophila* and is probably parasitic on it, and a few Ichneumonids of uncertain status. Apart from *Iridomyrmex humilis*, Mayr, the Reduviid, *Coranus papillosus*, Thnb., was the chief predator observed. Data are given on the effectiveness of most of the parasites in individual orchards or seasons.

A letter is quoted from C. C. Hattingh, who states that although in two sections of a pear orchard, one of which was sprayed and the other left unsprayed from 1939, the increases in percentage parasitism by *T. luteum* between 9th October 1939, when it was 0, and 12th December 1940, when it was 84·3 and 86·2 per cent., respectively, were about equal, the increase began sooner and took place more rapidly in the unsprayed section, in which the parasite appeared much earlier and was more abundant in the following season. Percentage parasitism in the unsprayed section on 13th November and 4th December 1939 was 3·8 and 33·8, respectively, whereas in 1940 the corresponding percentages for 14th November and 2nd December were 63 and 86; parasitised eggs were present as early as the beginning of October. Very few late entries were found on unsprayed pears at harvest time, but this type of damage was fairly common on sprayed fruit.

Preliminary experiments on the extent to which *Cydia pomonella* is controlled by natural enemies in the absence of spraying were made between 1934 and 1942 in pear orchards that had previously been regularly sprayed. Infestation was heavy in the first year in which sprays were omitted, but there was a tendency for the percentage parasitism to increase. In the second and third years of one experiment, infestation was no greater than when spraying was still practised and compared favourably with that in a neighbouring sprayed orchard. In another orchard that was typical of conditions in hot inland districts and that had yielded no parasites in collections in 1937–38 and 1938–39, one section was left unsprayed from 1939. Parasitism of 0·5 per cent. was recorded in both sections in 1939–40, and this increased to 1·3 per cent. in the sprayed and 3·7 per cent. in the unsprayed section in 1941–42.

A. quadridentata was responsible for most of it. Further data in 1942 indicated that populations of first-generation moths were increasing in the former and decreasing in the latter. The percentage parasitism in a mixed orchard in which sprays had not been applied for 11 years was 7·9 in 1941–42 and the percentage infestation at harvest about 13·9.

In a discussion of problems associated with biological control, the author states that there is little doubt that sprays, particularly lead arsenate, are detrimental to the natural enemies of *C. pomonella* [*cf.* **23** 317; **26** 555] and have thus favoured its increase. The experiments showed that heavy losses must be expected when spraying is first discontinued, until populations of parasites and predators are built up and a balance is reached. The time required for this varies with local conditions. In one experimental orchard, infestation decreased in the third season after the cessation of spraying, but in this case there had been opportunity for the building up of parasite populations in a neighbouring orchard that had not been sprayed for 2½ years prior to the experiment and that was then uprooted. In the fourth season, infestation was still lower, but rose slightly in the fifth, and was therefore probably not then stabilised. The available evidence from two small isolated orchards indicates that the average level at which stabilisation is likely to occur is economically satisfactory, but the position might be less favourable in larger and less isolated orchards. As yet there is no indication of the possible ultimate position in hot inland areas. The establishment of several larval and pupal parasites would tend to prevent wide fluctuations in population level.

Suggested measures for reducing infestation during the first years after spraying is discontinued are the mass liberation in spring, preceded if necessary by releases in late summer and autumn, of pupal and larval parasites, supplemented by the application of a modified spray programme. Where liberations of parasites do not reduce spring-brood infestation sufficiently to prevent heavy crop losses, the judicious use of sprays containing fixed nicotine, which is known to be the least harmful to parasites [**26** 555], should restrict to 200 per tree the number of larvae to become full-grown without seriously affecting the parasites. Preliminary tests indicate that most of the parasites already present, as well as the two recently introduced Ichneumonids, can be reared on a large scale for liberation in spring on larvae collected in the autumn. The author has also successfully reared small numbers of *C. pomonella* by a method developed for *Argyroploce leucotreta*, Meyr. [**28** 641]. *Cryptus* sp. has been found to breed successfully in pupae of *A. leucotreta*, which could be employed as hosts if pupae of *Cydia* were not obtainable during the winter.

Pseudococcus spp., *Aonidiella aurantii*, Mask., *Bryobia praetiosa*, Koch (*pratensis*, Garm.) and *Icerya purchasi*, Mask., which usually have to be controlled by dormant sprays on pear in South Africa, ceased to be of importance in the unsprayed orchards. Infestation by *Eriophyes pyri*, Pgst., increased, but a treatment previously used against this mite, comprising one or two applications of wettable sulphur in spring, would probably not injure the parasites. A tendency towards heavy infestations of *Ceratitis capitata*, Wied., was noticed on pears in unsprayed orchards and those in which lead arsenate was replaced by fixed nicotine in all but the first two sprays. The ineffectiveness of fixed nicotine against this fruit-fly has already been demonstrated, and its increase in orchards in which lead arsenate has not been used indicates that the residues of this material are toxic to it.

HATTINGH (C. C.). **A Study of Codling Moth Oviposition in a mixed Pear Orchard.**—*J. ent. Soc. sthrn Afr.* **5** pp. 137–146, 3 refs. Pretoria, 1942.

The time to apply sprays against eggs of *Cydia* (*Carpocapsa*) *pomonella*, L., on pear in western Cape Province is generally determined by bait-trap records, which, however, do not give a true criterion of oviposition, but only indicate

the number of moths in flight [*R.A.E.*, A **29** 435]. Egg counts based on sampling methods and related to data on moth populations obtained from bait-traps or counts of empty pupal cases were expected to give some indication of the progress of oviposition by the overwintered generation, but preliminary work showed that accurate determination of the peak period of oviposition, especially in orchards containing several varieties, also involves consideration of the factors influencing the distribution of the eggs, most of which are laid on the fruiting points. The most important factors were found to be the relative attractiveness of fruiting points in different stages of development up to the fruit-setting stage and the time of flowering of different varieties. Investigations were accordingly begun on these factors in September 1940, in an orchard containing four varieties of pear. The eggs laid on marked fruiting points on trees of three varieties were counted every 3–4 days. In all varieties, maximum oviposition occurred during the full-bloom and petal-fall stages, and it is thought that the former is the more attractive, since the petals of some of the flowers probably dropped between the times of oviposition and examination.

In view of these results, the distribution of the eggs in the orchard at different times must be considerably influenced by the times at which the different varieties come into bloom. Various observations indicated that moths ready for oviposition are generally present in mixed orchards when the earliest varieties begin to flower [**30** 401], and experiments showed that at the beginning of the flowering season most eggs are laid on the varieties on which fully-open flowers first occur. As more varieties come into flower, the extent of oviposition on any variety depends on the number of fruiting points of that variety that are attractive to the moths, which is determined by the number of fruit-buds per tree and the duration of the full-bloom stage, both of which show considerable varietal variation, as well as the number of trees of that variety present in the orchard. Egg-counts must therefore be made on all varieties to obtain an accurate estimate of the distribution and general abundance of eggs in an orchard. Furthermore, it is necessary to compare bait-trap records of a particular variety with egg-counts on the same variety in order to correlate peak bait-trap captures with peak oviposition. In addition to varietal differences in time of flowering, there are also differences between trees of the same variety and fruiting points on the same tree, and the number of eggs on each fruiting point varies inversely with the number of fruiting points in full bloom on the tree. To compensate for these factors, it is suggested that as large a number of representative fruiting points per tree on as many trees as possible should be examined daily to determine the state of development and the number of eggs on each ; to estimate the situation throughout the whole orchard, the average number of fruiting points per tree should also be ascertained. When estimates of the number of fruiting points per tree, made after the observations in the orchard were concluded, were considered with the data obtained in these observations, it was found that maximum oviposition did not occur on the date on which the highest number of eggs was laid per fruiting point, but on that on which the largest number of fruiting points was in the most attractive stage. The peak of oviposition on any one variety in a mixed orchard may not be closely associated with the general peaks of emergence and oviposition in the orchard as a whole, and discrepancies in the results of other workers on the relative dates of maximum bait-trap catches and maximum oviposition are thought to be due to failure to take these factors into account.

Ullyett (G. C.) & v[an] d[er] Merwe (J. S.). **A Note on Technique for Routine Examinations of parasitic Hymenopterous Larvae.**—*J. ent. Soc. sthrn Afr.* **5** pp. 147–151, 2 refs. Pretoria, 1942.

In view of the importance in practical biological control of the routine identification of the larvae of parasitic Hymenoptera, a simple and quick

technique for the preparation of specimens for microscopic examination is essential. A description is given of a technique developed by the authors, and its advantages over other methods are discussed.

HAMERSMA (P. J.), STOFBERG (F. J.) & NAUDE (C. P.). **The Fluorine and Arsenic Content of Cabbage after Dusting with Insecticides: Cryolite, Arsenate of Lead and Calcium Arsenate.**—*Sci. Bull. Dep. Agric. For. S. Afr.* no. 13, 21 pp., 37 refs. Pretoria, 1942.

A detailed account is given of investigations in the Transvaal to determine the fluorine and arsenic residues remaining on cabbages at harvest after dusting with cryolite, lead arsenate and calcium arsenate, which are commonly applied in the Lowveld for the control of *Plutella maculipennis*, Curt. The local tolerance for arsenic on vegetables is 1·4 parts As_2O_3 per million (0·01 grain per lb.). There is no official tolerance for fluorine, but it is stated that one of 1·4 parts per million may soon be enforced. The dusts used were cryolite and talc (50 : 50) containing 22·2 per cent. fluorine and mixtures of lead arsenate or calcium arsenate and talc (20 : 80) containing 5·1 and 6·6 per cent. As_2O_3, respectively, and applications were made at rates of up to about 60 lb. per acre 2, 4, 6 or 9 weeks after planting and on various combinations of these dates. The unwashed plants were analysed at harvest, which began 33 days after the last application, and the results are given separately for the outer, intermediate and inner leaves. The residues of fluorine and arsenic trioxide on the intermediate and inner leaves in no case exceeded 1·4 parts per million. The results for the outer leaves were somewhat inconsistent and may have been affected by rainfall, but in most of the cases in which the residues exceeded the tolerance, the last application of dust had been made less than 60 days before harvest. The residues on the outer leaves also exceeded the tolerance when 2·33 gm. of the cryolite mixture and 1·51 gm. of the lead arsenate mixture were applied to the crown of each plant with a teaspoon 5 weeks after planting, though the plants were not harvested until 70 and 73 days later.

CHERIAN (M. C.). **Our present Position with Regard to the Control of Fruit Pests.**—*Madras agric. J.* **30** no. 1 pp. 14–17. Madras, 1942.

In view of an expected increase in fruit growing in Madras, a short account is given of the major Arthropod pests of the principal fruit trees grown there. The most important pests of mango are *Idiocerus* spp. [*cf. R.A.E.*, A **28** 465], the Lamiid, *Batocera rubus*, L., the larvae of which bore into the trunk and branches, causing them to dry up, and are destroyed by injecting mixtures of chloroform and creosote (1 : 1) or kerosene and petrol (10 : 1) into deep tunnels and closing the entrance holes with clay or by extracting larvae that are just under the bark with flexible wire, and the fruit-flies, *Dacus ferrugineus*, F., and *D. f. incisus*, Wlk., which feed in the fruit pulp in the larval stage and are controlled by systematic destruction of fallen fruits, raking up the soil round the trees when the larvae have pupated, spraying with a dilute solution of crude oil emulsion to repel ovipositing flies and enclosing the fruits in bags. The leaves are occasionally attacked by the larvae of *Parasa lepida*, Cram., and the Pyralid, *Orthaga exvinacea*, Hmps., which webs them together

Fruit-piercing moths of the genus *Ophideres*, which breed on the weed *Tinospora*, sometimes cause considerable loss of *Citrus* fruits and are usually controlled by destroying the weed, screening the fruits with palmyra baskets, spraying them with repellents or hand-picking the moths, which become stupefied when a light is directed towards them. Since they prefer tomatos to *Citrus* fruits, tomato plants are being grown to fruit at the same time as *Citrus*, to serve as a trap crop. *Papilio demoleus*, L., defoliates *Citrus*, causing much damage to young plants. Hand-picking of the larvae is economical and efficient,

and big trees can be sprayed with an arsenical. The bark borer, *Indarbela* (*Arbela*) *tetraonis*, Moore, which occurs chiefly in the Circars, is killed with pointed wires or by injections of a mixture of kerosene and petrol (10 : 1). The leaf-miner, *Phyllocnistis citrella*, Staint., does serious damage to young plants; suggested methods of control are spraying with repellents and rubbing infested leaves to crush the insects in the mines. Other insects that sometimes cause injury include the stem-borer, *Chelidonium* sp., *Dacus* sp., *Aphis citricidus*, Kirk. (*tavaresi*, Del G.) and *Pulvinaria* sp.

Grape vines are often attacked by the Eumolpid, *Scelodonta strigicollis*, Motsch., which feeds on the leaves and tender shoots, and by *Tetranychus telarius*, L.; arsenical sprays are effective against the former and sulphur dust against the latter. *Pulvinaria psidii*, Mask., the chief pest of guava, can be controlled with contact sprays, and *Carpomyia vesuviana*, Costa, which attacks the fruit of ber [*Zizyphus jujuba*], by raking up the soil round the trees while the pupae are in it. The most important pest of pomegranate is *Virachola isocrates*, F., protection from which is afforded by enclosing the fruits in bags. The woolly apple aphis [*Eriosoma lanigerum*, Hsm.] is a serious pest of apples, which are grown on a small scale on the hills. *Aphelinus mali*, Hald., has been introduced for its control, and recent surveys have shown 40 per cent. parasitism at the beginning of the season.

The author points out the necessity for further investigations on the manufacture of cheap insecticides from indigenous plants and the development of resistant varieties of plants and for a plant-quarantine service to prevent the introduction of additional pests.

CHERIAN (M. C.) & SUBRAMANIAN (C. K.). **Studies on *Diatraea venosata* Walk.—a Pyralid Pest of Sugarcane in South India.**—*Madras agric. J.* **30** no. 2 pp. 44–49, 9 figs., 5 refs. Madras, 1942.

Proceras (*Diatraea*) *venosatus*, Wlk., is accompanied on sugar-cane in South India by *P.* (*Argyria*) *sticticraspis*, Hmps., and *Scirpophaga rhodoproctalis*, Hmps. It was previously considered that *P. sticticraspis* was the most important of these Pyralids [*cf. R.A.E.*, A **21** 674; **23** 87], but recent observations at Coimbatore have shown that *P. venosatus* is mainly responsible for the reduction in tonnage and sucrose content of millable canes and partly responsible for the loss of young shoots. Damage by the larvae becomes evident from the third month, when the canes are beginning to form, and continues until harvest, and several generations are produced during this period. In young crops, the larvae feed in the central leaf-roll for about a week and then bore into the lower portions of the stem, causing the formation of dead-hearts. In older cane, the larvae bore in the internodes but do not affect growth. The percentages of canes and of internodes attacked on 6 varieties in 1938–39 and 4 in 1939–40 are shown in tables, together with the results of chemical analysis of infested canes. The average weight of the canes was reduced from 2·46 lb. when one internode was attacked to 2·18 lb. when 4–6 were attacked, but the quality of the juice was not materially affected.

Observations on *P. venosatus* on potted plants in the laboratory showed that females lay their eggs in masses of 2–60 on both surfaces of the green leaves near the mid-rib and occasionally on leaf-sheaths and stems; the maximum number of batches per female was 51, and the total number of eggs laid ranged up to 414. Not more than 37 eggs were observed in a mass in the field. The egg, larval and pupal stages lasted 5–8, 28–38 and 9–10 days, respectively. The half-dried leaf-sheaths were preferred for pupation, and males emerged before females. The adults survived for 3–4 days, and the females outlived the males by 1–2 days and oviposited for 2–3 days.

Activity is checked to some extent during the north-east monsoon owing to the accumulation of rain-water at the entrance to the larval burrow and the

development of a fungus, *Isaria* sp., on the larvae. The eggs are parasitised by *Trichogramma minutum*, Ril., and *Telenomus* sp. ; the larvae by *Glyptomorpha* (*Stenobracon*) *deesae*, Cam., *Xanthopimpla nursei*, Cam., *Pimpla* sp., *Rhaconotus roslinensis*, Lal, *R. scirpophagae*, Wlkn., *Goniozus indicus*, Ashm. [the species subsequently described under the same name by Muesebeck (**29** 137)] and *Apanteles flavipes*, Cam. ; and the pupae by *Tetrastichus ayyari*, Rohw., and *Trichospilus diatraea*, Cherian & Margabandu (MS.). *P. venosatus* was also found feeding on *Saccharum spontaneum* and maize, and further food-plants are recorded from the literature.

Tindale (N. B.). **Revision of the Ghost Moths (Lepidoptera Homoneura, Family Hepialidae). Part V.**—*Rec. S. Aust. Mus.* **7** no. 2 pp. 151-167, 3 pls., 30 figs., 1 ref. Adelaide, 1942.

One of the three genera dealt with is *Sahyadrassus*, which is more fully described than in the previous part [*R.A.E.*, A **31** 158]. It contains five species, two of which are new.

Marshall (Sir G. A. K.). **New Indian Curculionidae (Col.).**—*Ann. Mag. nat. Hist.* (11) **10** no. 62 pp. 105–119. London, 1943.

Notes on synonyms and homonyms in Curculionids are appended to this paper and among the new names proposed are *Metaplesius* for *Paraplesius*, Hartm., nec Först. (Hym.), *Rhabdoscelus* for *Rhabdocnemis*, Faust, nec Pomel (Spong.), and *Sipalinus* for *Sipalus*, Schönh., nec Fisch. (Mamm.).

Mosley (F. O.). **Chrysanthemum Capsid Control by atomized Pyrethrum Extract.**—*J. R. hort. Soc.* **68** pt. 1 p. 26. London, 1943.

Satisfactory results have been obtained against *Lygus pratensis*, L., and Aphids on chrysanthemums grown under commercial conditions in Britain with an oil-base pyrethrum extract, atomised through a multi-orificed nozzle by compressed air at a pressure of 35 lb. per sq. in. Application by this method causes the plants to be surrounded by a penetrating fog ; they should not be wet with the insecticide. The chrysanthemums are systematically treated, while standing in the open, at regular intervals of 7–10 days from mid-June until the time of housing. When the plants are housed or the buds are showing colour, an oil base is unsuitable, but a water base may be substituted, though it is not so effective. Most varieties, however, appear to be able to tolerate a considerable amount of the oil-base insecticide thoroughly and deliberately applied.

[Kavkazskaya-Tzege (V. V.) & Medvedev (S. I.).] **Кавказская-Цеге (В. В.) и Медведев (С. И.). The Black Beet Weevil (*Psalidium maxillosum* F.).** [*In Russian.*]—*Nauch. Zap. sakharn. Prom.* **17** no. 1-2 pp. 56–72, 8 figs., 15 refs. Kiev, 1940. [Recd. 1943.]

An account is given of the results of laboratory and field observations in 1933-38 on the bionomics of *Psalidium maxillosum*, F., in the Province of Krasnodar, where it causes considerable injury to sugar-beet and is the commonest weevil to attack this crop. All stages are described, and its distribution in the Russian Union and elsewhere is given. It was found that the adults live for up to 22 months and oviposit in two successive years, and the egg and pupal stages last 19–47 days and about a month. In 1937, oviposition began on 14th April, reached a peak in the second half of May and continued until 1st September. The first and last larvae hatched about the end of May and the beginning of

October. Most of the larvae overwintered in the third or fourth instar, and pupated in the following July and August, giving rise to adults that hibernated before leaving the soil, but a few late larvae overwintered in the first or second instar and again in the fifth. The young overwintered adults made their way to the surface in spring when the mean temperature of the soil at a depth of 4 ins. reached 12°C. [53·6°F.] and that on the surface 15°C. [59°F.] and migrated to suitable food-plants to feed and oviposit. They passed the night and the greater part of the day in the soil at a depth of 1–2½ ins., and did not leave it if the temperature on the surface was below 18°C. [64·4°F.] or above 35·5°C. [95·9°F.]. Maximum emergence occurred at about 30°C. [86°F.]. In May 1938, the periods of maximum activity were 10–11 a.m. and about 5 p.m.; and no weevils were observed at mid-day or between 6 p.m. and 9 a.m. In the evening, the weevils re-enter the soil even at temperatures that favour activity, which indicates that the latter is affected by light, and those kept under artificial light in the laboratory remained active and fed at very late hours.

Observations and experiments showed that the adults feed on the leaves, the young shoots and sometimes the flowers of plants of 130 species in 33 families ; lists of the latter and of the preferred cultivated and wild plants are given. Beet is readily attacked, but castor [*Ricinus communis*], cabbage, *Prunus* (*Amygdalus*) *nana*, and the weeds, *Convolvulus arvensis* and *Sisymbrium loeselii*, are preferred. Reproduction is probably parthenogenetic, as no pairing was observed in the field, and no males were found among 2,000 weevils dissected. Though the period of oviposition lasts from mid-April till the beginning of September, 45 per cent. of the eggs are laid between 10th and 20th May. The average numbers laid by first- and second-year weevils were 66 and 63, respectively, with maxima of 234 and 186. Actual oviposition took place in 2–8 periods of about a week each, with intervals of 1–3 weeks. The fact that the first-instar larvae predominated in the upper layer of the soil indicates that the eggs are probably laid near the surface. Oviposition begins at a temperature of about 20°C. [68°F.] and mass oviposition coincides with the end of the mass migration of the weevils. They begin to die out from about mid-May, having completed oviposition. Most of the old weevils die in July and all disappear by the beginning of October.

The larvae usually occur at depths of 6–24 ins. in the soil. They hibernate at all these depths, but chiefly at 12–16 ins., where the temperature is just above freezing point, and pupate at 12–16 ins. They feed on the roots of many plants ; a list is given of those attacked in experiments, of which beet and *Cirsium incanum* were preferred.

The weevils avoid low-lying or humid plots and soil that is shaded by densely growing plants. The most suitable habitats are fields of beet, vegetables, sunflowers or castor, and weedy fallow. Since the weevils cannot fly, foci of infestation may develop if favourable conditions obtain for 2–3 consecutive years. Examination in the autumns of 1935, 1936 and 1937 of soil in fields under a beet rotation showed that fields under beet were the most frequently infested with the hibernating stages of the weevil and those under winter wheat the least so.

Natural enemies include birds, lizards, toads, frogs, the green and red muscardine fungi [*Metarrhizium anisopliae* and *Tarichium uvella*], which kill up to 28 per cent. of the larvae in spring, and *Graphogaster maculatus*, Belanovskiĭ [*cf. R.A.E.*, A **26** 94], which parasitises the adults. This Tachinid probably has only one generation a year, and it is thought that the adults attack the weevils from mid-April to the end of May or beginning of June. The larvae live and hibernate in the abdomen of the host, and pupate there in spring, the adults emerging 10–12 days later. In 1936, 54 per cent. of the weevils taken on the surface of the soil towards the end of March were parasitised, each containing a single larva. By mid-April, the percentage of parasitised

individuals decreased, and later only a few were found. Pupae were first found on 28th March and continued to occur until mid-May. In 1938, the percentage parasitism did not exceed 5.

Measures suggested for control comprise the protection of birds; adequate crop rotation, including perennial fodder plants; planting beet at a distance from other beet fields; the use of trap-ditches; setting out trap heaps of grass or lucerne, under which the weevils concentrate, along the edges of the fields before the beet shows above ground; collecting the weevils from the upper layer of the soil; spraying with stomach insecticides; and the use of a poison bait. This bait is prepared by mixing 3 lb. Paris green with 40 gals. water and soaking 100 lb. dry oil-cake in it for 2–3 hours while stirring it frequently. The bait should be distributed in small holes 16 ft. apart and covered with soil. It is very effective and gave up to 95 per cent. mortality of the adults.

KAUFMANN (O.). **Ueber Reaktionen der schossenden Rapspflanze auf Rapsglanzkäferfrass und andere Schäden.** [On the Reactions of the developing Rape Plant to Feeding by the Rape Beetle and other Injuries.]—*Z. PflKrankh.* **52** pt. 11 pp. 486–509, 10 figs., 9 refs. Stuttgart, 1942.

A detailed account is given of investigations in Germany in 1940–42 on the relation between injury by adults of *Meligethes aeneus*, F., and loss of crop in rape. The growth habit of the rape plant and the methods adopted for growing it on a large scale are described, and it is pointed out that these methods are not the most favourable to the individual plant, which produces a much greater crop when isolated under optimum conditions than it does when growing near other plants in the rape field.

Observations on the dates on which feeding by *M. aeneus* occurs, the character of the injury and the reaction of the plant are recorded in detail. Feeding usually begins at the tips of the plants, and continues there for longer than in other situations. Up to 50 per cent. of the buds are sometimes totally destroyed at the tip when there is scarcely any injury lower down. If flowering has begun and large and medium-sized buds are present in sufficient number, injury to the plants is less, even though the number of beetles increases rapidly, than if the plants are attacked earlier, while the buds are still small. The plants have great regenerative power, and develop side shoots to replace the damaged tips, so that injury by the beetle is not directly related to loss of crop; plants artificially infested with 100 or 200 beetles gave a greater yield than the controls or plants infested with 50 beetles. Increased crop also followed when the buds at the top of the plant or the entire growing tip were artificially removed. Moreover, the physiological loss of buds is considerable and in many cases exceeds the loss due to the beetle.

EHRENHARDT (H.). **Untersuchungen über den Einfluss der Zehrwespe *Aphelinus mali* auf den Massenwechsel der Blutlaus unter Berücksichtigung der biologischen Bekämpfung der Blutlaus.** [Investigations on the Influence of *A. mali* on the Variation in Abundance of the Woolly Aphis with Regard to the biological Control of the Aphis.]—*Arb. physiol. angew. Ent. Berl.* **7** pp. 1–41. 1940. (Abstr. in *Z. PflKrankh.* **52** pt. 11 pp. 524–525. Stuttgart, 1942.)

An account is given of the establishment of *Aphelinus mali*, Hald., against *Eriosoma lanigerum*, Hsm., on apple in the orchard districts of the Lower Elbe [*cf. R.A.E.*, A **26** 347], and the variations observed in its abundance and that of its host. It spread throughout the orchard districts in 2–3 years and was observed at distances of up to 30 miles from the nearest point of liberation; transport by man, animals and wind is probably responsible for its spread over

such distances. Up to 68 per cent. of the Aphids were parasitised. The first generation of *A. mali* appears late, however, and the Aphid multiplies far more rapidly, so that it cannot be completely controlled.

VOBORIL (F.). **Seltene Schädlinge des heimischen Obstbaues.** [Rare Pests of German Orchards.]—*Dtsch. Obstbau* (B) 1940 pts. 7, 9, 12, repr. (Abstr. in *Z. PflKrankh.* **52** pt. 11 p. 525. Stuttgart, 1942.)

Typhlocyba rosae, L., was observed causing circular yellow spots on the upper surface of the leaves of apple in May ; if this Jassid is abundant it deforms the young leaves. The control measures recommended are a dormant spray of tar distillate, a lime-sulphur spray or mixed dusts of derris and pyrethrum. The Capsid, *Plesiocoris rugicollis*, Fall., overwinters in the egg stage on the shoot tips, buds and bark of apple. All stages occur in June, and the feeding of the bugs causes deformation of the leaves, shoot tips and fruits. A spray containing 0·5 per cent. nicotine and 1 per cent. soft soap should be applied before and after blossoming.

MANOLACHE (C.). *Acanthiophilus helianthi* **Rossi.** [*In Rumanian.*]—*Viața agric.* **31** p. 65. 1940. (Abstr. in *Z. PflKrankh.* **52** pt. 11 p. 526. Stuttgart, 1942.)

A brief account is given of the bionomics and control of the Trypetid, *Acanthiophilus helianthi*, Rossi, which infests up to 90 per cent. of the fruits of safflower (*Carthamus tinctorius*) in Rumania.

MANOLACHE (F.). *Heliothis obsoleta* **Fb.** [*In Rumanian.*]—*Viața agric.* **31** p. 355. 1940. (Abstr. in *Z. PflKrankh.* **52** pt. 11 p. 527. Stuttgart, 1942.)

Heliothis armigera, Hb. (*obsoleta*, F.), is recorded from cotton, tomato, tobacco and soy bean in Rumania, and a list is given of parasites of the eggs and larvae.

KNECHTEL (W.) & MANOLACHE (C.). *Pemphigus bursarius* **L.**—*Hort. român.* **18** no. 9–10. 1940. (Abstr. in *Z. PflKrankh.* **52** pt. 11 p. 526. Stuttgart, 1942.)

In 1940, the Aphid, *Pemphigus bursarius*, L., was very harmful to lettuce round Bucharest and in other places in Rumania.

WATSON (M. A.). **Sugar-beet Yellows Virus. A preliminary Account of Experiments and Observations on its Effect in the Field.**—*Ann. appl. Biol.* **29** no. 4 pp. 358–365, 2 pls., 1 ref. London, 1942.

The symptoms of virus yellows of sugar-beet, which vary with weather conditions and the state of the crop, are described in detail ; the principal ones are chlorosis, thickness and brittleness of the leaves [*R.A.E.*, A **24** 405]. They have long been familiar in commercial crops in Britain, but were not attributed to the virus until 1940 and their significance is not generally recognised. The virus is transmitted by *Aphis fabae*, Scop., and *Myzus persicae*, Sulz. [*loc. cit.*], of which the former is the more important in the field ; it is not transmitted mechanically [**29** 65] or through seeds. Infection may be distributed in the fields in large patches or in scattered groups of two or three plants. The former type of distribution probably occurs where individual plants are infected by alate Aphids early in the season, when only a few are infective, and the disease

is spread to the surrounding plants by apterae, and the latter where initial infestation occurs later, when many Aphids carry the virus, but the disease spreads more slowly since it appears to be more difficult for the Aphids to become established on mature plants.

Experiments with plants infected by *A. fabae* and *M. persicae* in experimental plots at Rothamsted in 1940–41 showed that the yield of roots and sugar were both considerably reduced by the disease. In 1941, the reduction in yield from plants sown late (19th May) and infected early (25th June) was as high as 67 per cent. for roots and 71 per cent. for sugar. The losses decreased with earlier sowing and later infection.

Although the disease is present in most sugar-beet fields, it is rare for more than 1 per cent. of the plants to be infected until late in the season, and losses due to it are probably not serious. Seed crops of sugar-beet appear to provide the main source of infection and the means by which the virus is carried over from year to year, since all the alternative weed hosts are annuals, and other crops, such as mangels in clamps, spinach, spinach beet, etc., on which it has been observed are removed before the sugar-beet root crops become infested by Aphids. Heavy infestations of *A. fabae* in which many alates are produced may occur on seed crops early in the year. Alates are rarely produced on root crops early enough for the yield to be seriously affected by a rapid increase in the number of infected plants; infection appears to be spread in them only by apterae, but alates from the root crops probably carry infection to the young seed-crop plants at the end of the season. The extent of infection in root crops is not directly related to the degree of Aphid infestation, since if this is heavy many Aphids have probably migrated from broad beans or other non-susceptible food-plants, whereas each individual in a light infestation from a nearby or highly infective source is capable of infecting several plants. Tests in glasshouses showed that comparatively few individuals in a population become infected in any one feeding experiment, infectivity is lost more rapidly when the Aphids are fasting than when they are feeding and the number of healthy plants they infect and the rate at which symptoms develop in the plants depend on the length of the fast. Observations over two years on sugar-beet in plots undergoing manurial trials at Rothamsted indicated that the development of severe infestations of *A. fabae* depends chiefly on the conditions affecting its reproduction, of which the condition of the crop and the weather are both of importance, and less on the size of the initial infestation or the time of year at which it appears. In these trials, infestation was lowest in plots in which the growth of the plants was improved by applications of agricultural salt and nitrogenous fertilisers, but their effect may not be sufficiently great to be of practical importance in the control of the disease.

Late sowing, poor cultural conditions and the close proximity of seed crops to root crops, which favour early and rapid spread of virus infection and the greatest loss in yield, are all likely to be aggravated by war-time conditions. Seed crops should not be grown in large root-growing areas and a close watch for early and heavy infestation should be maintained, especially in seed crops, so that control measures can be applied early.

Caldwell (J.) & Prentice (I. W.). **A Mosaic Disease of Broccoli.**—*Ann. appl. Biol.* **29** no. 4 pp. 366–373, 1 pl., 18 refs. London, 1942. **The Spread and Effect of Broccoli Mosaic in the Field.**—*T. c.* pp. 374–379, 1 pl., 1 fig.

Investigations on a mosaic disease of broccoli that is widespread in Devon and Cornwall, where it has occurred every year since 1936, and may result in complete loss of crop were made in 1938–41 and are here described. The first paper contains information on its symptoms and the host-range, methods of transmission and properties and nature of the virus. The symptoms cover a wide range; they are masked by hot weather and intensified by cold, which

causes the older leaves to fall and the young ones to remain small and to curve outwards, exposing the curd to rain and frost. In laboratory experiments, the virus was readily transmitted by abrasion and by *Brevicoryne brassicae*, L., and an unidentified Aphid, but not by *Aleurodes proletella*, L. (*brassicae*, Wlk.) or through the seed. It was observed in and transmitted to many kinds of cruciferous crops, and appears to be widespread on such crops in southern England. In other crops the symptoms are less severe than in broccoli.

B. brassicae is common on broccoli, particularly in seed-beds, and is the main vector in the field. The apterae became infective after feeding on diseased broccoli plants for 10 minutes and transmitted the virus in a feeding period of 20 minutes; small-scale experiments with alates gave negative results. Seedlings may become infected in spring from mature late broccoli or other crops and possibly from hedgerow weeds, though attempts to recover the virus from several common ones were unsuccessful, or from infected Aphids that live on these weeds after the removal of the preceding crop.

The literature relating to other virus diseases of cruciferous plants is briefly discussed, and it is concluded that broccoli mosaic is identical with the mosaic of cauliflower [*Marmor cruciferarum* of Holmes] described by C. M. Tompkins [*R.A.E.*, A **25** 756].

The second paper comprises an account of field observations in 1938–41, which indicate that the spread of infection can be reduced by placing the seed-bed in the middle of a large field, away from hedgerows, and by removing infected plants early in the season. In 1939, the seedlings were sprayed on 19th May and 3rd–6th June with nicotine and soap against *B. brassicae*, but infection was not reduced. Repeated applications are necessary if infestation is heavy to destroy Aphids migrating from hedgerows, and the cost of this is considerable. Where infestation was slight, the number of Aphids was probably too small to cause much infection.

PETHERBRIDGE (F. R.), WRIGHT (D. W.) & DAVIES (P. G.). **Investigations on the Biology and Control of the Carrot Fly** (*Psila rosae* **F.**).—*Ann. appl. Biol.* **29** no. 4 pp. 380–392, 3 graphs, 4 refs. London, 1942.

Observations in eastern England in 1941 showed that adults of both generations of *Psila rosae*, F., were more abundant on the headlands and dike-sides than in the middle of carrot fields. [*cf. R.A.E.*, A **31** 24]. During high wind or rain, they sheltered on broad-leaved plants and low bushes. Adults of the overwintered generation emerged in carrot fields from 14th May until 28th July and in the dike-side adjoining a carrot field from about 26th May until 12th August. First-generation adults emerged between 12th August and 16th October. Adults of both generations fed on flowers of wild chervil (*Anthriscus sylvestris*) and hemlock (*Conium maculatum*), and the larvae fed and matured on the roots of hemlock, which is common in fen districts and from which they have not previously been recorded. In June, eggs were observed round celery plants; the larvae mine in the stem and leaf stalks and may cause considerable damage. Wild carrot [*Daucus carota*] and other wild umbelliferous plants were not attacked. Eggs were most common round the edges of the carrot fields; most were laid within $\frac{1}{4}$ in. of the plants. More were laid on the older seedlings with 6 leaves than on younger ones. Adults taken early in November and kept in an unheated insectary deposited viable eggs; those taken at the end of the month laid many eggs, but none hatched, and adults taken in December did not oviposit. Oviposition and hatching probably occurred in the field during autumn and early winter, since larvae considerably less than half grown could be found until mid-December. Few larvae leave the carrots to pupate until late winter or early spring. Carrots sown at intervals from April until late June were injured to a similar extent, but attack decreased progressively on

those sown later. Deterioration from larval attack in unlifted carrots was most rapid in October and November ; it was less rapid and extensive in carrots in clamps.

Attempts to control adults of the overwintered generation on early carrots by means of derris dust [*cf.* **27** 497] were unsuccessful. Large numbers of first-generation adults were killed by spraying the dike-sides and headlands with a bait-spray containing 0·8 per cent. sodium fluoride and 2·5 per cent. cane molasses. Ten applications were made between 19th August and 29th September at intervals of 3–7 days, the shortest intervals being during the peak emergence period. The percentage of uninfested carrots in treated fields varied from 81 to 91, whereas that in untreated fields varied from 63·5 to 85·5, the lower figure in each case referring to roots from the headlands, where attack was always greater than in mid-field. The authors state in an appended note that this treatment again resulted in high mortality and a marked reduction in damage in 1942. In small-scale experiments, some control was given by placing grass cuttings along the rows ; the best results were obtained when an application of a dust of 4 per cent. calomel [mercurous chloride] at the rate of 1 lb. per 120 ft. row on 6th August was followed immediately, and again on 21st August and 11th September, by dressings of grass cuttings, which resulted in 58·5 per cent. of the carrots being unattacked and only 14·2 per cent. unmarketable, as compared with 34·2 per cent. in each category in the untreated controls. No decrease in infestation resulted from sowing onions with carrots.

Thompson (H. W.). *Crambus hortuellus* **Hb. as a Grassland Pest.**—*Ann. appl. Biol.* **29** no. 4 pp. 393–398, 1 pl., 7 refs. London, 1942.

Injury to grassland by larvae of *Crambus hortuellus*, Hb., was observed for the first time in England in 1941, when areas in Yorkshire ranging up to several acres were damaged. The attacks were confined to upland fields with acid soil and poor herbage in which fescues [*Festuca* spp.] and bent grass [*Agrostis*] predominated, and resulted in the destruction of the grass, which was cut off at ground level and left lying on the ground. Severe injury was first noted during September, and by 17th October most of the larvae had formed cocoons among the bases of the plants or lightly embedded in the soil, in which they evidently overwinter, since no pupae had been found by the end of January. In October, the numbers of healthy cocoons varied from 48 to 128 per square foot, but the original populations were probably considerably higher, since natural enemies were found to exert a fair degree of control. The presence of old cocoons indicated that the population had been built up over two or more years. Relatively large numbers of larvae were dead or moribund ; some showed symptoms of attack by a fungus, apparently *Isaria* sp., and others of bacterial disease. The larvae were attacked after, as well as before, cocoon formation. Others were parasitised by Tachinids, and a Hymenopterous larva was found in one cocoon. Birds fed on the larvae both before and after the formation of the cocoons. Larvae placed in soil on 17th October and kept at 30°C. [86°F.] constructed cocoons in a few days and adults emerged in mid-November.

The measures recommended for control were designed to re-establish the turf and improve the herbage rather than to destroy the cocoons. They comprise raking off and removing the dead herbage, harrowing to cut up the turf mat, and applying lime in autumn and a phosphatic fertiliser in spring to encourage better types of grass. In North America, crops on ploughed-up grassland infested by Crambids or near infested grassland are liable to attack, but there appears to be little risk of injury to winter wheat in such situations in Britain, since very little is sown before the cocoons are formed. The larvae of many American species feed in spring before pupating, and if *C. hortuellus* should do so in England, some damage to spring crops might occur.

HICKIN (N. E.). **The Food and Water Requirements of** *Ptinus tectus* **Boieldieu (Coleopt., Ptinidae).**—*Proc. R. ent. Soc. Lond.* (A) **17** pt. 10–12 pp. 99–108, 10 refs. London, 1942.

An account is given of experiments in which *Ptinus tectus*, Boield., was reared at accurately controlled temperatures, in foodstuffs in equilibrium with controlled relative humidities. Of 1,493 adults dissected, 46·8 per cent. were females. Adults and young larvae are negatively phototropic, but full-fed larvae are indifferent to light ; groups of adults and larvae subjected to temperatures ranging from −8 to 2°C. [17·6–35·6°F.] for seven days and nights in December 1938 were quiescent, but recovered after 12 hours at 15°C. [59°F.]. The foods employed (plain and wholemeal wheat flour, casein and rice flour) contained much the same amount of free water at any given humidity when they were in equilibrium with relative humidities of 10–90 per cent., except that casein contained appreciably less than the others at humidities of up to 60 per cent.

When groups of full-fed larvae were placed in the culture cages the percentages that transformed to adults were 6, 46 and 89 at 40, 50 and 60 per cent. humidity and 27°C. [80·6°F.], and 45, 60 and 85 at 60, 70 and 80 per cent. and 20°C. [68°F.]. None did so at humidities of 10, 20, 30, 90 or 100 per cent. The numbers of adult progeny per female were greatest in wholemeal and rice flours and least in casein. The durations of the life-cycle in all foods averaged 15·4 and 10·7 weeks at 27°C. and 50 and 60 per cent. humidity and 19, 23·3 and 25·1 weeks at 20°C. and 60, 70 and 80 per cent., the shortest time being 10·5 weeks on wholemeal flour at 60 per cent. humidity and 27°C. and the longest 36 weeks in casein at 80 per cent. humidity. In all materials but rice flour (which was not used in this comparison), the life-cycle was about twice as long at 20 as at 27° ; increasing the humidity from 70 to 80 per cent. increased the average duration of the life-cycle in plain flour and casein, but did not affect it in wholemeal flour. The average durations of the pupal stage were 12·7, 11·3 and 11 days at 40, 50 and 60 per cent. humidity and 27°C. and 13·8, 16·1 and 13·4 days at 70, 80 and 90 per cent. and 20°C., and the corresponding average periods of maturation of the adults were 8·3, 9·7 and 7·25 days and 9·5, 7·4 and 10 days. All the larvae died in their cocoons at 10 and 30 per cent. humidity.

Starved adults that were given water survived longer at almost all humidities than those that were not, and their survival apparently depended on temperature and not relative humidity. Some eggs and larvae were found in all cages, indicating that oviposition occurs in the absence of food. Reproduction was greater amongst adults given water and food than amongst those given food only. The addition of yeast powder to plain flour or casein or of yeast powder or wheat germ to potato starch accelerated development and increased the number of offspring. The few larvae that developed in pure potato starch apparently did so by eating the dead bodies of other larvae.

KALMUS (H.). **Differences in Resistance to toxic Substances shown by different Body Colour Mutants in** *Drosophila* **(Diptera).**—*Proc. R. ent. Soc. Lond.* (A) **17** pt. 10–12 pp. 127–133, 11 refs. London, 1942.

Previous investigations have shown that the darkening of the cuticle in Diptera is due to a tanning process caused by polyphenols and results in its hardening and dehydration, and that the lighter mutants of four species of *Drosophila* die earlier and lose weight more rapidly than their wild type sibs when starving in a dry atmosphere. In this paper, the results are given of experiments showing that the darkening of the cuticle of *Drosophila melanogaster*, Mg., and *D. pseudoobscura*, Frol., race A, decreases its permeability to mineral oils and oil-soluble substances as well as to various water-soluble

substances. The mutants and the technique used are briefly described and specifications of the substances tested are given. When uniform deposits of heavy mineral oil, light oil (kerosene), an emulsion of a tar distillate (creosote oil) in water (0·8 per cent.), pyrethrum extract in water and sulphuric acid in water were applied to groups of 40 flies of known and fairly uniform age, consisting of ten each of wild type males and females and mutant males and females, which had been immobilised with carbon dioxide, the light mutants of both species showed a higher percentage mortality after a given time than the wild types and one dark mutant in *D. melanogaster* survived longer than the wild type after treatment with heavy oil or sulphuric acid, though another showed no significant differences. In similar tests with smaller numbers of *D. pseudoobscura*, the light mutant lost significantly more weight than the wild type after spraying with light or heavy oil, and collapse of the eyes of the dead flies after treatment with light oil was significantly more frequent in the light mutant than in the wild type.

It is not certain that the differences in reaction of the mutants to all the chemicals used are due to a common cause, but it is probable that a dark cuticle is less permeable to the substances tested than a lighter one, owing to the formation of a firmer and stabler cuticular structure. Since inherited differences in resistance to toxic agents can provide the raw material for selection, it is possible that chemical selection may favour the survival of the darker members of an insect population that is subjected to treatment with insecticides, resulting in the development of a resistant race, and that the greater protection against toxic substances conferred by a dark cuticle may be the cause of the progressive replacement in industrial and urban districts of light individuals of many species of insects, mainly Lepidoptera, by darker mutants.

LEVER (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **13** no. 3 pp. 81–82, 8 refs. Suva, 1942.

The distribution of *Nezara viridula* var. *smaragdula*, F., in Fiji [*cf. R.A.E.*, A **31** 42, etc.] has been found to include three of the Lau Islands, on one of which it is a pest of asparagus, broccoli, bean and tomato; the parasite, *Microphanurus basalis*, Woll., has been liberated on two of these islands. The author states that this Pentatomid is a pest of rice, cowpea, pigeon pea [*Cajanus cajan*], *Crotalaria*, pumpkin, cucumber and okra [*Hibiscus esculentus*] in New Britain and of various plants in Tonga and has been taken on peas in Fiji. It has recently been recorded from Papua. The giant toad, *Bufo marinus*, was received in the Ellice Islands from Suva in November 1939, and in February 1940 it was sent from Fiji to the British Solomon Islands Protectorate, where it is said to be thriving on Guadalcanal and other islands that are much hotter and moister than any in Fiji. Roots of *Derris elliptica*, grown and stored for months in Sigatoka, were found to be bored by *Xylothrips religiosus*, Boisd., and an unidentified species of *Minthea*. An unidentified Chalcid parasite and two predators, *Tenebroides mauritanicus*, L., and a Reduviid, were present. Reference is made to control measures recommended in Malaya [*cf.* **22** 615].

PAPERS NOTICED BY TITLE ONLY.

MARLOWE (R. H.). **Some recent Advances in Insecticides** [a review of the literature].—*Proc. Hawaii. ent. Soc.* **11** no. 2 pp. 177–194, 129 refs. Honolulu, 1942.

UVAROV (B. P.) & THOMAS (J. G.). **The probable Mechanism of Phase Variation in the Pronotum of Locusts.**—*Proc. R. ent. Soc. Lond.* (A) **17** pt. 10–12 pp. 113–118, 4 figs., 9 refs. London, 1942.

NOTICES.

Secretaries of Societies and Editors of Journals willing to exchange their publications with those of the Institute are requested to communicate with the Director.

The Annual Subscription, *in advance*, to the Review, Series A (Agricultural), is 30s. post free; Series B (Medical and Veterinary), 15s. post free. Subscriptions to the *current* Volume received after 30th June in each year will be charged at the published price *viz.*: Series A, 36s.; Series B, 18s. Prices of Back Volumes on application.

Orders and Subscriptions should be sent to the Director, Imperial Institute of Entomology, 41, Queen's Gate, London, S.W.7, or through a bookseller.

CONTENTS.

CONTENTS—*cont.*

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE
by the South Essex Recorders, Ltd., Ilford

(644) Wt. F11/8728 1,500 5/43 S.E.R. Ltd. Gp. 432.